8-6-2012

# Are Maternal Child Health Outcomes Affected by Adequacy of Prenatal Care in Montgomery County, OH?

Amy Rouse
*Wright State University - Main Campus*

# Are Maternal Child Health Outcomes Affected by Adequacy of Prenatal Care in Montgomery County, OH?

Amy Rouse, MD, MPH Candidate
Culminating Experience, CMH 820/821
Wright State University
Boonshoft School of Medicine
and
Center for Global Health
August 6, 2012

## Table of Contents

Page

Abstract ..... 3

Introduction ..... 4

Statement of Purpose ..... 7

Literature Review ..... 7

Methods ..... 25

Results ..... 31

Discussion ..... 48

Conclusion ..... 63

References ..... 65

Appendices ..... 75

## Abstract

Background: Prenatal Care has been recommended by the World Health Organization for all pregnant women in order to improve health outcomes of the mother and the child. However, recommendations for the number of visits required to provide adequate health care and improve outcomes continue to be debated. Understanding if adequate prenatal care is improving maternal child outcomes is essential before making these recommendations. This research aims to determine if in Montgomery County, OH the adequacy of prenatal care influenced gestational age at birth, birth weight, breastfeeding rate, rate of cesarean sections, and smoking cessation rates.

Methods: De-indentified birth data was collected from Public Health - Dayton & Montgomery County for 2007-2009. Data regarding patient demographics, number of prenatal visits, gestational age of newborn, birth weight, breastfeeding rate, smoking cessation, and method of delivery was extrapolated from the original data set. Using ACOG guidelines, the number of women who received adequate (11 or more prenatal visits) and inadequate prenatal care and their outcomes (gestational age, birth weight, breastfeeding, cesarean section rate, and smoking cessation) was determined. Chi squared, Odds Ratio's, and logistic regression were used to determine statistical significance for each outcome based on adequacy of prenatal care.

Results: The odds of having a premature baby were significantly increased (OR 1.78; CI1.61, 1.97) for woman who received inadequate prenatal care. Odds of low birth weight for inadequate prenatal care (<11 visits) was 1.89 (1.71-2.08). The odds of breastfeeding were 1.6 (1.52; 1.72) times greater if having received adequate prenatal care, the odds of receiving a cesarean section with adequate prenatal care was 1.23 (CI: 1.14; 1.32), and the odds of quitting smoking was 1.21 (CI: 1.00; 1.46).

Conclusion: Adequate prenatal care positively affected the risk of premature birth, low birth weight, and significantly increased breastfeeding rates. However, risk of cesarean section was significantly more likely if the woman received adequate prenatal care, raising concern for inappropriate encouragement by physicians. Smoking cessation rates showed no difference based on adequacy of prenatal care which demonstrated that woman who quit smoking were motivated by something more than just increased interaction with their physician.

# Are Maternal Child Health Outcomes Affected by Adequacy of Prenatal Care in Montgomery County, OH?

Prenatal care is defined by the World Health Organization (WHO) as healthcare during pregnancy that constitutes "screening for health and socioeconomic conditions likely to increase the possibility of specific adverse pregnancy outcomes, providing therapeutic interventions known to be effective; and educating pregnant women about planning for safe birth, emergencies during pregnancy and how to deal with them" (WHO, Statistical Information System, 2008). It is estimated by the Department for Health and Human Services (2009) that women who do not receive prenatal health care are three times more likely to have a low birth weight baby and babies of mother's who do not receive prenatal care are five times more likely to die. Furthermore, a study of Missouri's Medicaid patients found that mother's receiving adequate prenatal healthcare (defined by the Kessner Index) saved the health care system an average of $1.49 per $1.00 spent on prenatal care (Schramm, 1992).

Adequate prenatal health care has been defined by numerous different indices. The first prenatal healthcare began in Europe with the recommendation of 16 visits during pregnancy (Carroli, Rooney, & Villar, 2001). However, Carroli et al. (2001) found in a meta analysis of over 60,000 women that when four prenatal visits did not occur, there was an increased risk for any of the reviewed perinatal outcomes (including low birth weight and infant mortality). This led the WHO to define adequate prenatal care as four prenatal care visits, recommended for all pregnant women globally. However, other indices have been developed such as the Kessner Index/Institute of Medicine Index which states for a pregnancy ≥36 weeks, a woman should received at least 9 prenatal visits to be considered "adequate." However, this index defines "inadequate" as a women ≤ 34 weeks gestation receiving less than four prenatal visits and

everything in between as “intermediate” (Kotelchuck, 2001). The American College of Obstetricians and Gynecologists (ACOG) and the US Department of Health and Human Services both recommend adequate prenatal care as once monthly visits beginning between weeks 6-8 through 28 weeks and twice monthly visits between weeks 29-36. This equates adequate prenatal health care to 10 visits at 36 weeks gestational age. The guidelines recommend weekly thereafter 36 weeks, thus a full term 37 week gestation should have 11 prenatal visits (American Congress of Obstetricians and Gynecologists, 2011). The Adequacy of Prenatal Care Utilization Index (APNCU) states adequate prenatal care should start in the fourth month or earlier and should constitute at least 80% of the ACOG recommendations. Intermediate care begins in months five or six and is 50-79% of ACOGs guidelines and inadequate prenatal care was documented as care beginning greater than the sixth month of gestation and less than 50% of the number of visits recommended by ACOG (Kotelchuck, 1994).

This leads to the question, what is adequate prenatal health care and what does it do? In the United States, the standard of care is the ACOG guidelines, which recommend 11 visits for a 37-week baby. According to the WHO (2012), adequate prenatal care provides a method for early detection and intervention of the leading causes of morbidity and mortality of both the pregnant woman and her baby during the pregnancy and immediately following, ensuring the healthiest pregnancy and delivery as possible. In addition, it allows for contact with an educated medical professional giving an opportunity for education regarding healthy habits for both the mother and baby. It is recommended at all prenatal visits in the US to screen for tobacco, alcohol, and drug use and provide appropriate counseling. In addition, at each visit, it is recommended that there be discussion and promotion of breastfeeding. This is in addition to physical exams including approximate size and gestational age of the baby, listening to heart

tones, screening exams, lab tests, and cultures that occur through out the pregnancy (Prenatal Care Schedule; Wellmark Blue Cross and Blue Shield, 2011).

Although the goal of prenatal healthcare is to decrease morbidity and mortality for both the mother and baby, there has been an unfortunate spike in cesarean section rates in western cultures for "no indicated reason." It has been documented that up to 21% of cesarean sections have been found at a later date to be "inappropriate" and up to 14% to have no clear advantage or disadvantage (Ostovar et al., 2010). Cesarean sections provide enormous benefit to the outcomes of both the mother and the baby when used appropriately. However, when used inappropriately, the surgery and procedure for both the mother and baby poses unnecessary harm and health risks. The increasing rate of cesarean sections has rising more dramatically in western cultures, where on average, more women receive adequate prenatal health care. This poses a potential concern that increasing number of prenatal care visits is coinciding with an increased cesarean section rate, which may in up to 21% of the cases cause more potential harm that good. This, unfortunately, is the exact opposite effect that prenatal health care is supposed to have on pregnant women and their unborn babies.

Due to the perceived benefits of adequate prenatal health care and the stated risks involved with inadequate prenatal health care, prenatal health care in Montgomery County, Ohio and the United States, is a resource offered to all pregnant women either through private insurance or through free clinics. However, this research proposes to determine if adequate prenatal care in Montgomery County, Ohio has given the improved maternal child health outcomes that it is aimed to provide. Specifically, this paper will determine if having received adequate prenatal health care in Montgomery County, Ohio between the years 2007-2009 showed improved outcomes of prematurity, low birth weight, likelihood to breastfeed at

discharge from the hospital, and smoking cessation rates. Furthermore, this paper also assesses the incidence of cesarean sections based on number of prenatal visits. Additionally, the demographics of the women not receiving adequate prenatal care are determined in order to better understand the population at risk.

It is of utmost importance to understand the impact prenatal care on the health outcomes of women and babies. This information will allow medical professionals to better understand the true effects of adequate prenatal care in Montgomery County, OH and aims to offer areas of improvement for better outcomes.

## Statement of Purpose

1) What are the demographics of the women receiving adequate vs. inadequate prenatal care in Montgomery County, Ohio for years 2007-2009?

2) Are there differences in maternal child outcomes for those women who receive adequate vs. inadequate prenatal care?

Outcomes include:

- Gestational Age
- Birth Weight
- Method of delivery (vaginal vs. cesarean section)
- Likelihood to breastfeed upon discharge from hospital
- Smoking cessation

## Literature Review

### Prenatal Health Care

Prenatal Care, as stated by the World Health Organization (WHO), is recommended for all pregnant women. The WHO states that, “during pregnancy, both the woman and her developing child face various health risks. For this reason, it is important that all pregnancies should be monitored by a skilled care provider” (World Health Organization, 2011). In the

United States, the Federal Government Source for Women's Health Information quotes that "women who do not receive prenatal care are three times more likely to have low birth weight babies and five times more likely to die than mothers who do get care" (US Deptarment of Health and Human Services, 2009). In the US in 1995, according to the Institute of Medicine (IOM) Index, which indicates 9 prenatal visits to be considered "adequate" prenatal care (Table 1), it was estimated that 74.1% of mother's delivering singleton babies received adequate prenatal care (Kogan et al., 1998) (Table 1). The American Congress of Obstetricians and Gynecologists (ACOG), however, recommends that pregnant women should see their doctor once a month for the first 28 weeks, twice until 36 weeks, and weekly thereafter (American Congress of Obstetricians and Gynecologists, 2011). This equates >11 prenatal visits for a full term pregnancy (40 weeks gestation; Table 2) and is the same recommendation followed by the US Department of Health and Human Services (HHS).

**Table 1.** ***Comparison of prenatal care Indices***

| | **IOM** | **GIndex** | **GIndex Revised** | **APNCU(ACOG)** |
|---|---|---|---|---|
| **Adequate start of care** | 1-3 mos | 1-3 mos | 1-3 mos | 1-4 mos |
| **Adequate number of visits** | 9 | 9 | 13 | 11 |
| **Intensive visit category?** | No | Yes | Yes | Yes |

(Source: Alexander & Kotelchuck, 1996)

**Table 2.** ***ACOG guidelines for number of adequate prenatal care visits based on gestational age***

| Gestational Age (Weeks) | 6-8 (2Mo) | 9-12 (3Mo) | 13-16 (4Mo) | 17-20 (5Mo) | 21-24 (6Mo) | 25-28 (7Mo) | 29-32 (8Mo) | 33-36 (9Mo) | 37 | 38 | 39 | 40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of Visits by Week | 1x | 1x | 1x | 1x | 1x | 1x | 2x | 2x | 1x | 1x | 1x | 1x |
| Total Number of Visits | 1 | 2 | 3 | 4 | 5 | 6 | 8 | 10 | 11 | 12 | 13 | 14 |

The HHS also endorses increased visits if the mother is over age 35. However, according to the APNCU Index, which follows the ACOG and HHS prenatal care guidelines, only 44.6% of women had "adequate" prenatal care in 1995 (Table 3) (Kogan et al., 1998). Given the strong

recommendations by the Department of Health and Human Services, ACOG, and the WHO for all women to receive adequate prenatal care, it stands to be determined if this care is positively influencing health outcomes of new babies and their mother's as anticipated.

**Table 3.** ***Intensive and Adequate Prenatal Care Utilization Among Singleton and Multiple Births, 1981 and 1995****

| | 1981 | | 1995 | |
|---|---|---|---|---|
| Prenatal Care Measure | Singletons (n) | Multiples (n) | Singletons (n) | Multiples (n) |
| R-GINDEX, % intensive use | 3.3 (97 187) | 8.5 (4994) | 6.3 (227 698) | 22.8 (21 694) |
| R-GINDEX, % adequate use | 28.9 (840 621) | 48.0 (28 046) | 40.1 (1 445 491) | 54.3 (51 679) |
| APNCU Index, % intensive use | 17.9 (519 057) | 47.1 (27 506) | 27.7 (1 000 586) | 70.8 (67 470) |
| APNCU Index, % adequate use | 45.4 (1 321 484) | 29.1 (17 007) | 44.6 (1 610 145) | 16.4 (15 592) |
| IOM Index, % adequate use | 67.0 (1 948 033) | 68.4 (39 954) | 74.1 (2 673 727) | 80.7 (76 918) |
| Trimester care began, % at first trimester | 76.9 (2 235 924) | 78.1 (45 664) | 81.5 (2 940 271) | 85.4 (11 257) |

*APNCU indicates the Adequacy of Prenatal Care Utilization; IOM, Institute of Medicine.

(Source: Kogan et al., 1998)

## Preterm Delivery

The goal of prenatal care is to reduce morbidity and mortality associated with pregnancy and childbirth for both the mother and infant. It is estimated that approximately 28% of all infant deaths worldwide are due to prematurity (Lawn, Wilczynska-Ketende, & Cousens, 2006) and 36% of all deaths are considered "preterm related" (Mathews & MacDorman, 2011). In the US in 2007, the infant mortality rate was 6.75 infants per 1,000 live births. Infants born late pre-term (34-36 weeks) were 3.5 times more likely to die than full term babies and those born early term (37-39 weeks) were 1.5 times more likely to die than those born at term (39-41 weeks). Of all the deaths related to prematurity, 54% were considered "very pre-term" (<32 weeks gestation; Mathews & MacDorman, 2011).

For those premature babies who survive, their lifetime morbidity is also of concern. It is known that premature children who survive have worse developmental outcomes than those children born at term (Vieira & Linhares, 2011). Additionally, premature children are at a much higher risk for both acute and long term complications of the respiratory and gastrointestinal

tract, central nervous system, auditory and visual complications and long-term motor and cognitive deficits (Behrman & Butler, 2007).

The complications of prematurity clearly place a huge emotional burden on the families and also a financial one. The estimated cost of premature birth in the US in 2005 was greater than $26.2 billion annually (Behrman & Butler, 2007). It is also estimated that the lost market productivity due to the disabilities incurred among premature infants is $5.7 billion annually (Behrman & Butler, 2007).

It is clearly advantageous for prenatal health care to target reducing premature birth in order to reduce the clear mortality associated with prematurity but also the morbidity associated with the long term outcomes of prematurity. Not only is it physically and developmentally devastating to the newborn infant, but it is also emotionally and financially draining for the families and the economy. Attending adequately scheduled prenatal health care visits offers the opportunity for the physician to implement multiple strategies to reduce the risk of prematurity. Thus, decreasing the burden on the infant, families, and the society.

However, the literature states that the affect of prenatal care on reducing prematurity is inconclusive. What has been documented most readily is that prenatal care allows the opportunity for appropriate medial interventions for both the mother and the baby including antibiotics, steroids, surfactant, fluid management, and resuscitation methods to be available at the time of delivery. Possibly most importantly, prenatal care allows for premature babies to be immediately transferred to neonatal intensive care units where their chances of survival are the greatest (Goldenberg & Rouse, 1998). However, there is no clear evidence to support that adequate prenatal care visits actually reduce the risk of prematurity. This is demonstrated by data taken from the National Center for Health Statistics (1981-1995), demonstrating that since 1981,

the percent of babies born preterm has actually been steadily increasing. However, the percent of women receiving inadequate prenatal care (defined as 3 visits or less) has actually steadily decreased during this same time period. If the attendance of adequate prenatal care directly decreased the risk of prematurity, then as more women have access and attend adequate prenatal care visits, the rate of prematurity should also decrease. Although this was not the case, what did decrease was the overall neonatal mortality rate (Table 4) (Alexander & Kotelchuck, 2001).

**Table 4.** ***Annual trends in low birth weight, preterm delivery, inadequate use of prenatal care as defined by the R-GRINDEX, and infant mortality***

**R-GINDEX,[30] and infant mortality: 1981–1995 single live births to US resident mothers**

| *Year* | *Percent of low birthweight (<2,500 g) births* | *Percent of preterm deliveries (<37 weeks)* | *Percent with inadequate prenatal care use* | *Infant mortality rate* |
|---|---|---|---|---|
| 1981 | 6.8 | 9.4 | 13.5 | 11.9 |
| 1982 | 6.8 | 9.5 | 13.6 | 11.5 |
| 1983 | 6.8 | 9.6 | 12.9 | 11.2 |
| 1984 | 6.7 | 9.4 | 12.7 | 10.8 |
| 1985 | 6.8 | 10.0 | 12.4 | 10.6 |
| 1986 | 6.8 | 10.2 | 12.1 | 10.4 |
| 1987 | 6.9 | 10.2 | 11.8 | 10.1 |
| 1988 | 6.9 | 10.6 | 11.9 | 10.0 |
| 1989 | 7.0 | 10.6 | 12.5 | 9.8 |
| 1990 | 7.0 | 10.8 | 12.1 | 9.2 |
| 1991 | 7.1 | 10.7 | 11.6 | 8.9 |
| 1992 | 7.1 | 11.0 | 10.9 | 8.5 |
| 1993 | 7.2 | 11.0 | 10.0 | 8.5 |
| 1994 | 7.3 | 11.0 | 9.4 | 8.0 |
| 1995 | 7.3 | 11.0 | 9.0 | 7.6 |

SOURCE OF DATA: National Center for Health Statistics (US). 1981–1995 natality data sets. Additional analysis by Michael Kogan, PhD, NCHS

(Source: Alexander & Kotelchuck, 2001)

## Birth Weight

LBW is defined by the WHO as any infant born <2.5kg and very low birth weight (VLBW) is <1.5kg. Morbidity and mortality associated with low birth weight is difficult to separate from prematurity, as approximately 50% of low birth weight (LBW) babies are due to prematurity and the rest are due to intrauterine growth restriction (Lopez & Choonara, 2009). The Centers for Disease Control and Prevention (CDC) indicates that from the years 1980-2000, the incidence of low birth weight babies (<2,500g) increased by 11.8% and the incidence of very low birth weight babies (<1,500g) increased by 24.3% (MMWR, 2002). However, it is stated that these increases are likely due to the increase in premature births due to changes in obstetrical

practices including induction of labor, increased births of multiple babies, and increased cesarean section rates. Therefore, the importance of prenatal care in attempt to reduce prematurity becomes two fold, not only to reduce the complications associated with prematurity, but also to reduce the complications of low birth weight which may or may not be independent from the morbidity and mortality caused from prematurity.

Low birth weight (<2,500g) and very low birth weight (<1,500g) babies are at a significantly higher risk for morbidity and mortality directly related to their birth weight compared to their normal birth weight counterparts (Ferre, Handler, Hsia, Barfield, & Collins, 2011). The risk of the baby dying is inversely related to the baby's weight. The risk of dying was significantly lower for babies weighing between 3.0 and 4.99kg than babies of LBW or VLBW (Matthews et al., 2007). However, in the US, babies born <2.5kg are at a 25 times greater risk of infant mortality than those born ≥2.5kg. Furthermore, babies born <1.5kg are at 108 times greater risk of dying than those babies ≥2.5kg (Lopez & Choonara, 2009).

For low birth weight babies, the risks are not only significant during the neonatal period but they are also at an increased risk throughout their life for several adult chronic diseases (Ferre et al., 2011). In particular, low birth weight babies have an increased risk of coronary artery disease and stroke later in life. For instance, 1kg increase in birth weight is associated with a 20% decrease in coronary heart disease and stroke (Clayton et al., 2007). Low birth weight babies and high birth weight babies are both at a higher risk for type 2 diabetes and glucose intolerance (Clayton et al., 2007). Furthermore, low birth weight is independently linked to cognitive impairment and in particular, small for gestational age babies (those found at least 2 SDs below the average for their gestational age in height, weight, and head circumference), have

higher difficulty with mathematics and reading comprehension, and have increased emotional, conduct, and hyperactivity disorders (Clayton et al., 2007).

It is well believed that adequate prenatal care decreases the rate of low birth weight (<2,500g) and very low birth weight (<1,500g) babies subsequently reducing the poor medical outcomes associated with low birth weight and decreasing the large medical costs associated with taking care of these babies. Many currently public health programs aim to decrease the rate of low birth weight under these assumptions, by increasing access to prenatal care (Ferre et al., 2011). However, the literature to support this idea is conflicting.

According to a study conducted in Arizona reviewing mother's enrolled in the Arizona Health Start Program, which aims to increase pregnant women's access to prenatal care, women enrolled were twice as likely to deliver babies of normal weight than those women who were not enrolled in the program (Hussaini, Holley, & Ritenour, 2011). It has also been documented by Ferre, Handler, Hsia, Barfield, and Collins (2011) that inadequate prenatal care is a direct risk factor for low birth weight. Ferre et al. (2011) also documented a decrease in non-Hispanic black low birth weight babies between the years 1990-2001 which was associated with an increase in modifiable risk factors and protective factors including increased first trimester prenatal care. However, from 2001-2004 the rate of low birth weight babies in the non-Hispanic black community began to rise without direct correlation and not linked to a direct decrease in number of prenatal care visits (Ferre et al., 2011) (Figure). Furthermore, Kogan et al. (1998) documented a significant increase in prenatal care from 1981-1995 per the IOM index (Table 4), but they found no subsequent change in low birth weight rates.

A study in Finland of over 57,000 pregnant women demonstrated that the worst infant outcomes were in the group of women who had the most prenatal care visits (Gissler &

Hemminki, 1994). Although there was a U shaped relationship between infant outcomes (including low birth weight) and number of prenatal visits, the women with the most prenatal visits had unexpectedly worse outcomes, even worse than those receiving the least prenatal care. This led researchers to recommend decreasing the amount of prenatal care in Finland without adversely affecting infant outcomes, including low birth weight (Gissler & Hemminki, 1994).

Research continues to demonstrate unclear evidence that adequate prenatal care decreases the risk of low birth weight rates. However, decreasing low birth weight babies and premature babies either together or separately, is one of the strongest reasons for the World Health Organization and the US Department of Health and Human Services to advocate for access to adequate prenatal care around the world. So much so, that decreasing the number of low birth weight babies is one of the WHO's Millenium Development Goals for reducing child mortality. However, the evidence that adequate prenatal care actually reduces the rate of low birth weight babies remains inconclusive.

**Smoking Cessation**

Smoking cessation during pregnancy is recommended at all prenatal care visits in the US for mother's who are smoking during pregnancy. This is because it has been documented since 1957 that smoking during pregnancy decreases birth weight (Simpson, 1957) which, as mentioned previously, has huge impacts on infant mortality and morbidity throughout life. Multiple studies have also shown a direct dose-response effect and therefore recommendations by physicians for smoking mothers to at least decrease the amount they smoke if they cannot completely quit may prove beneficial (DiFranza, Aligne, & Weitzman, 2004).

It is difficult to separate if the morbidity associated with smoking is a direct cause of the smoke inhalation during pregnancy or if it is secondary to the lower birth weight of babies born.

However, regardless if the direct cause, babies born to smoking mothers have an increased risk of miscarriage, stillbirth, and neonatal death by 25-30% (Couriel, 1994). In the US a study of 2,720 infant deaths reported the infant mortality rate of babies born to smoking mothers to be 12.1 per 1,000 live births vs. 7.6 per 1,000 babies born to non-smokers. Furthermore, this same study found that after controlling for maternal age, parity, educational and marital status, and for birth weight, the odds ratio for dying from respiratory disease was 3.4 for babies born to mothers who smoke and the odds ratio for sudden infant death syndrome (SIDS) was 1.9 (Malloy, Kleinman, Land, & Schramm 1988). These authors also estimated that if no mother smoked during pregnancy, the infant mortality rate would decrease by 10%, the rate of SIDS would decrease by 28%, and death from respiratory disease would decrease by 46% (Couriel, 1994). However, the authors do note that since 90% of mothers who smoke during pregnancy continue to smoke after birth, determining the rate of SIDS and death from respiratory due to smoking during pregnancy versus smoking after pregnancy is difficult to determine (Couriel, 1994; Malloy et al., 1998).

It has also been shown that maternal smoking during pregnancy and smoking exposure in infancy is also associated with significant morbidity for the child. Increased ear infections, behavioral problems, and neurocognitive deficits have all been documented at an increased rate in children born to mothers who smoked during pregnancy (DiFranza, Aligne, & Weitzman, 2004). In addition, Hackshaw, Rodeck, and Boniface (2011) found an increased odds (with statistical significance) of cardiovascular/heart defects, musculoskeletal defects (including limb reduction defects and clubfoot), craniosynostosis, facial defects (including eye defects and facial clefts), gastrointestinal defects (including gastroschisis and anal atresia), hernias, and

undescended testis in infants of mothers who smoked during pregnancy versus those who did not.

Therefore, it is clear why smoking cessation is top target of prenatal care visits and according to ACOG should be addressed at every visit. However, according to a study by Filion et al. (2011), smoking cessation counseling in pregnant women yielded scant results. According to their meta-analysis, the women randomized to smoking cessation counseling who remained smoke-free at 6 months was between 4-24%. Controls ranged from 2-21% smoking cessation. This yielded a maximum difference of 4% (OR 1.08, 95% CI 0.84-1.4). They ultimately recommended the possibility of pharmacological therapy for smoking cessation in pregnant women as counseling therapy itself was not sufficient.

Thus, smoking cessation in pregnancy has clear benefits but the method of cessation therapy is still undecided. While adequate prenatal care visits offer the opportunity for smoking cessation education, it is clear that this does not produce sustainable abstinence. Research has not yet determined if other methods of smoking cessation such as pharmacological therapy recommended by Filion et al. (2011) yields the desirable affects theorized. However, attending adequate prenatal care visits would offer an opportunity for physicians to offer multiple different cessation strategies.

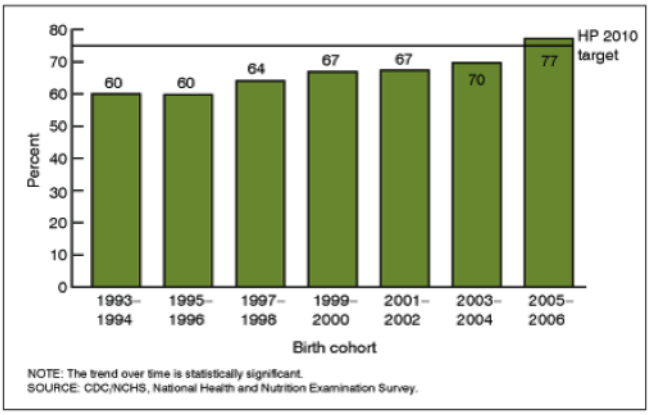


***Figure 1*. Percentage of infants who were ever breastfed by birth cohort; United States, 1993-2006. HP= Healthy People. Percent= Percent of infants ever breastfed.** (Source: Centers for Disease Control and Prevention, 2010b).

**Breastfeeding**

It is recommended by the American Academy of Pediatrics, American Academy of Family Physicians, ACOG, Association of Women's Health, Obstetrical, and Neonatal Nurses, Le Leche League, National Medical Association among many other organizations that mothers exclusively breast feed their infants for the first six months of life (Ip et al., 2007). It was also a goal of *Healthy People 2010* to have 75% of mothers initially breast feed and 50% still exclusively breastfeeding at six months (Ip et al., 2007). In the US 73% of women report ever breast-feeding and 30% report continuing to exclusively breast feed at six months (CDC, 2005). However, this has increased in recent years. The CDC (2010b) also states that from 1993-1994 only 60% of U.S. babies were ever breast fed compared to >70% currently (Figure 1) (CDC, 2010b). Continuing to increase breastfeeding rates has been a huge focus for US Public Health Departments and the WHO.

Breast milk contains all the appropriate nutrients for a growing newborn, in addition to containing antibodies from the mother to help promote the newborn's immune system and fight off infections (World Health Organization, 2011). Breast milk also contains factors that facilitate the uptake of nutrients such as Vitamin D, Calcium, and Iron into the newborn intestine (Rautava & Walker, 2009). The WHO (2011) states that, "breastfeeding reduces child mortality and has health benefits that extend into adulthood." In addition to health benefits, breastfeeding creates a unique bond between the mother and infant (Rautava & Walker, 2009).

Around the world, the WHO estimates that 1.5 million lives under the age of 5 could be saved from breast-feeding each year (WHO, 2010). It is estimated that if 90% of pregnant women initiated and sustained breastfeeding for 6 months in the US, it would save $13 billion per year and 911 infant lives (Bartick & Reinhold, 2010). However, an earlier review article in

the US found unclear evidence that breastfeeding reduced the risk of infant mortality. This same study, however, found very clear statistical evidence that breastfeeding reduced the risk for SIDS (Ip et al., 2007). These authors found that the adjusted odds ratio for an association between breastfeeding and a reduced risk of SIDS was 0.64, (CI 0.51; 0.81) (Ip et al., 2007).

Breastfeeding also has a significant impact on decreasing morbidity in infants, including having a positive imapct on growth and development and decreasing the risk of many acute and chronic diseases (Imdad, Yakoob, & Bhutta, 2011). In a study conducted at UC Davis, it was found that breast- feeding offered significant improvement on morbidity even in the US. For example, it was found that in the first year of life, the episodes of diarrheal illness in breast-fed infants was 50% lower than those that were formula fed. Additionally, the incidence of otitis media was 19% lower in breast fed infants and the incidence of otitis media lasting >10 days was 80% lower in breast fed infants vs. formula fed infants (Dewey, Heinig, & Nommsen-Rivers, 1995). Ip et al. (2007), also found that infants who were ever breast fed had an odds ratio of 0.77 (95%CI 0.64 – 0.91) for acquiring acute otitis media.

In a review of over 46 journal articles by Infants with a family history of atopy had a significant reduction in developing atopic dermatitis if exclusively breastfed for at least three months. There was a 72% reduction in the risk of hospitalization due to respiratory diseases in infants who were exclusively breastfed for four months or more compared with those who were formula-fed. The pooled adjusted odds ratio of overweight/obesity comparing ever breast-feeders to never breast-feeders was between 0.76 (95%CI 0.67–0.86) and 0.93 (95%CI: 0.88–0.99) (Ip et al., 2007). Ip et al. (2007) also found there was a reduction in total and LDL cholesterol levels in adults who were breastfed during infancy compared with those who were formula-fed. They also found the adjusted odds ratio of type 2 diabetes later in life for ever breast-fed compared to

formula fed was 0.61 (95%CI 0.44–0.85). Finally, the authors also concluded that there was a small decrease in risk of acute mylogenous leukemia and acute lymphocytic leukemia in infants who were breastfed for at least six months (Ip et al., 2007).

The WHO (2011) states that women need extensive education, training, and support to initiate and continue breastfeeding and thus launched the Baby Friendly Hospital Initiative to help strengthen and support breast-feeding. Additionally, it has been noted that professional support in the prenatal period has the potential to increase both the intent and duration of breastfeeding in pregnant women (Kervin, Kemp, & Pulver, 2010). Kervin, Kemp, and Pulver (2010) also demonstrated that prenatal classes significantly improved the likelihood that women breastfed after delivery, demonstrating that 86.8% of women who attended prenatal classes intended to breastfeed (half of whom intended to breastfeed for at least 1 year) vs. only 27.0% of women who did not attend prenatal classes (p=0.0028). Kervin, Kemp, and Pulver (2010) also stated that the most influential method of support to increase breastfeeding rates was breastfeeding support during the first half hour of delivery from health care professionals. They found 89.7% of women who received professional support for breastfeeding within the first half hour of delivery continued to exclusively breastfeed vs. only 22.2% of women who did not receive support (p=0.001).

Thus, the benefits on both infant mortality and morbidity that can be decreased by breast-feeding infants exclusively for at least six months are clear. It is also documented that health care professionals play a large role in increasing the rates of breastfeeding. Therefore, it is apparent how much of a necessity it is in a women's prenatal visits to utilize this time to educate and promote exclusive breast-feeding.

**Cesarean Section**

Cesarean section rates have risen dramatically over the years. The percent of cesarean sections rose from 20.7% in 1996 to 31.1% in 2006, 32.2% in 2008, and currently averages nearly 50% in the US (Figure 2) (MacDorman, Menacker, & Declercq, 2008; Queenan, 2011; Births, Final Data, 2008).

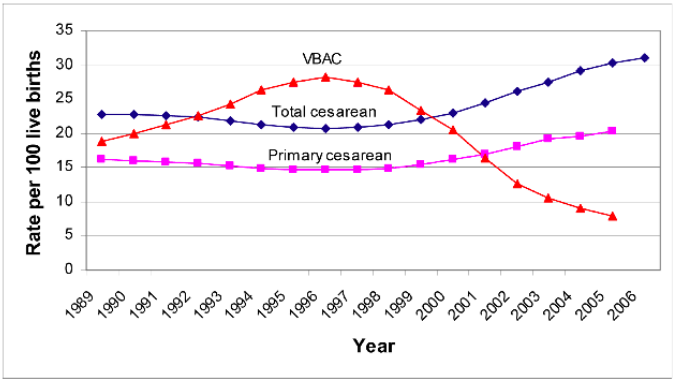


***Figure 2.*** **The Total cesarean, Primary cesarean, and vaginal birth after cesarean rates in the US, 1989-2006.**
(Source: U.S. National Center for Health Statistics, Ramachandrappa & Jain, 2006.)

There has been an overall increase in both primary and secondary cesarean sections, however a more substantial increase in primary cesarean sections of "no indicated risk" (MacDorman, Menacker, & Declercq, 2008). Rates of cesarean sections for "no indicated risk" or for "maternal request" are estimated to be 4-18% of all cesarean sections worldwide, and between 2.5%-5.5% of all cesarean section in the US (Ramachandrappa & Jain, 2008). Hospital discharge data ranks primary cesarean deliveries of no medical or obstetrical indication to be between 3% and 7% (Menacker, Declercq, & MacDorman, 2006). Declercq, Sakala, Corry, and Applebaum (2006) found an increased rate of cesarean sections between 1996-2002 but without a corresponding increase in maternal risk factors. Of note, there has also been a drastic decrease in the percent of vaginal deliveries after primary cesarean section from 28.3% to 9.2% between

1996 and 2006 and thus in 2006, a repeat cesarean delivery rate of almost 91% (Menacker, Declercq, & MacDorman, 2006).

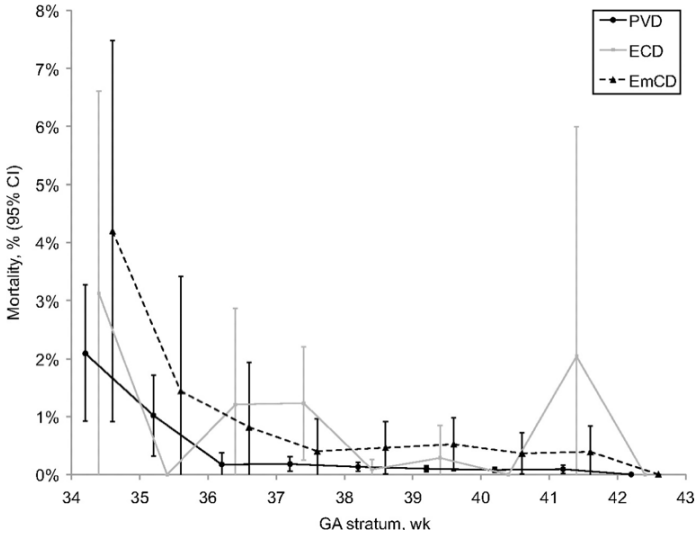


***Figure 3.*** **Intra-partum and pre-discharge mortality: elective (ECD, light gray) and emergency cesarean delivery (EmCD, dark gray and interrupted line), and planned vaginal delivery (PVD, black). EmCD indicates emergency CD.**
(Source: De Luca, Boulvain, Irion, Berner, and Pfister, 2009)

Cesarean Sections are linked to a number of poor infant and maternal outcomes including a neonatal mortality rate 2.4 times higher in women who had cesarean sections with no medical risk factors and were low-risk births and had an adjusted odds ratio for neonatal mortality of 1.69 (95% CI: 1.35-2.11) (MacDorman, Declercq, Menacker, & Malloy, 2008). A study by De Luca, Boulvain, Irion, Berner, and Pfister (2009) also showed an increased mortality rate after elective cesarean delivery compared with vaginal delivery in term neonates to be 0.41% vs 0.11% with a RR: 3.72 ($P < .001$) (Figure 3). However, it has also been documented that the risk of mortality due to elective cesarean section may be offset by the risk of fetal demise over 40 weeks gestation. It has been estimated that from weeks 37-41 the rate of fetal demise per 1,000 live births increases from 1.3-4.6 with each week of gestation (Hankins, Clark, & Munn, 2006). Therefore, demonstrating an argument for elective cesarean sections over 40 weeks gestation.

However, there is also significant morbidity associated with elective cesarean sections, or cesarean sections of no indicated reason. It has been documented that planned cesarean deliveries at full term, compared to planned vaginal deliveries, almost doubled the risk of pulmonary disorders and transfers to the Neonatal Intensive Care Unit (NICU). Planned cesarean delivery increased transfer rates to the NICU from 5.2% to 9.8% (P < .001) according to one study and elective term cesarean sections carried a RR: 1.71 (P = .001) of being transferred to the NICU (Figure 4) (De Luca, De Luca, Boulvain, Irion, Berner, & Pfister, 2009; Kolås, Saugstad, Daltveit, Nilsen, and Øian, 2006). The risk for pulmonary disorders (transient tachypnea of the newborn infant and respiratory distress syndrome) rose from 0.8% to 1.6% (P = .01) (Kolås et al., 2006). De Luca et al. (2009) also documented almost twice as frequent episodes of respiratory morbidity after elective cesarean section compared with vaginal deliveries in term neonates 3.5% versus 1.7% with a RR: 2.05 (P = .001) (Table 5).

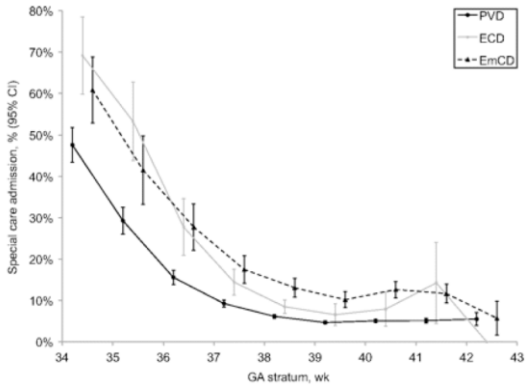


***Figure 4.*** **Admissions to Special Care. ECS (light gray), EmCS (dark gray and in- terrupted line) and PVD (black). EmCD indicates emergency CD.**
(Source: De Luca et al., 2009)

**Table 5.** ***Rate and RR of Selected Neonatal Outcomes According to PVD***

| | ECD, % (*n*/*N*) | PVD, % (*n*/*N*) | RR | 95% CI | *P* | aRR[a] | 95% CI | *P* |
|---|---|---|---|---|---|---|---|---|
| Mortality[b] | 0.54 (14/2574) | 0.14 (76/53 256) | 3.83 | 2.16–6.78 | <.001 | 2.09 | 1.07–4.09 | .031 |
| Birth depression | 21.4 (551/2574) | 20.5 (10 926/53 254) | 1.06 | 0.96–1.16 | .275 | 1.07 | 0.96–1.18 | .209 |
| Admission | 14.7 (377/2558) | 6.7 (3529/52 918) | 2.42 | 2.16–2.71 | <.001 | 1.41 | 1.23–1.60 | <.001 |
| Respiratory morbidity | 5.5 (88/1593) | 2.1 (487/23 396) | 2.75 | 2.18–3.47 | <.001 | 1.80 | 1.38–2.34 | <.001 |

CI indicates confidence interval.

[a] Adjusted for GA, malformations, intrauterine growth retardation, twin/multiple births, macrosomia, gender, and year of birth.

[b] Includes intrapartum mortality and predischarge mortality.

(Source: De Luca et al., 2009)

To further complicate the issue, it is estimated in the Netherlands, that up to 50% of the elective cesarean sections occurred <39 weeks gestational age and in the US, elective cesarean sections, on average, occurred eight days earlier than spontaneous vaginal deliveries (De Luca et al., 2009). This poses even more risk for the neonate. Being delivered via cesarean section at $37^{+0-6}$ weeks had an odds ratio of 2.4 (CI 2.1, 2.8) compared to vaginal deliveries at the same age for primary outcomes[1] including neonatal mortality. Babies born by elective cesarean section weeks $38^{+0-6}$ also had an odds ratio of 1.4 (CI 1.2-1.5) for all primary outcomes. Specifically, the odds of respiratory distress syndrome at $37^{+0-6}$ and $38^{+0-6}$ compared to vaginal deliveries for the same age group was 3.8 (CI 1.4–10.5) and 1.9 (CI 0.8–4.5), respectively.

Therefore, adequate prenatal care should aim to reduce the number of elective cesarean sections (or cesarean sections for which no indication can be found), not increase them. This is one of the the best ways to promote and ensure the safest outcomes for both the mother and the newborn and not increasing the risk for the newborn of both mortality and morbidity. Unfortunately, Aron, Gordon, DiGiuseppe, Harper, and Rosenthal (2000) demonstrated that women with private insurance had the highest rate of cesarean section rates, measuring 17% vs.

[1] Composite measure of neonatal mortality until the 28th day after birth, and/or neonatal morbidity consisting of any of the following adverse events: severe resuscitation, sepsis, respiratory complications (registered as respiratory distress syndrome [RDS], wet lung syndrome or transient tachypnea of the newborn [TTN], pneumothorax or air leakage), respiratory support (oxygen, intermittent positive pressure ventilation [IPPV], continuous positive airway pressure [CPAP]), hypoglycemia, convulsions, intracranial hemorrhage, admission to the neonatal intensive care unit, admission to any neonatal ward ≥5 days and a 5-minute Apgar score ≤3

14.2% and 10.7% for government insurance and uninsured respectively. With private insurance, patients are more readily able to have adequate prenatal care visits, and theoretically a lower cesarean section rate since complications can be identified and handled earlier in the pregnancy. However, the data shows that this is not currently the case.

**US Demographics**

In the US, the rate of preterm births was 12.2%. For non-Hispanic white women, 10.9% delivered prematurely vs. 17.9% of non-Hispanic Black women (State Health Facts, 2009). In 2009 and 8.2% of babies were born LBW (<2500g). Non-Hispanic White women had a LBW rate of 7.2% vs. 13.6% of non- Hispanic Black women in the US (State Health Facts, 2009). Only 3.3% of LBW babies were born full term (37-41 weeks gestation). The percent of full term LBW babies (37-41 weeks) in the U.S. for non- Hispanic white women was 2.6%, for non-Hispanic black women was 5.4%, (National Vital Statistics Report, 2011). The teen birth rate is ranked as 38.9 in Ohio and 39.1 in the nationally (State Health Facts, 2009). 41% of pregnant women were unmarried in 2011 and the mean age of first birth was 25.2 (CDC FastStats, 2012). According to the National Vital Statistics Report, since 1996 cesarean rates in the US have risen by over 50% to a total of 32.3% of all live births in 2009. Of these cesarean births, 53% were to non-Hispanic white women, 16% were to non- Hispanic black, and 22% were to Hispanic women in 2009.

It has also been documented that there is a significantly higher rate of cesarean sections in women of higher income and higher education level (Norton, 2011). Education and age seem to play a role in mothers who smoke during pregnancy. In the US, 20% of women reported smoking during pregnancy and of those, 20% were <25 years old versus only 9% aged >35 and

22% of those who smoked had <12 years of education (American Pregnancy Association, 2012; Hackshaw, Rodeck, & Boniface, 2011).

There are many demographics in the US that put a woman at risk of not receiving adequate prenatal care. Being African American has been a risk factor since the 1980's for not receiving adequate prenatal care and African American women were twice as likely as white women to receive no care at all (Institute of Medicine, 1989). Women at the extremes of ages also have a higher risk, in particular women under age 15 and over age 40 are the least likely to receive adequate prenatal care (Institute of Medicine, 1989). Furthermore, education has always played a major role in the likelihood of a women receiving adequate prenatal care. Since 1985, 88% women with at least some college education had adequate prenatal care compared to 58% of women with less than a high school diploma (Institute of Medicine, 1989). Although Medicaid has been a large influence on increasing the ability for minorities to receive inadequate prenatal care, women with private insurance have statistically remained more likely to receive adequate prenatal care in the U.S. since the 1980s (Institute of Medicine, 1989).

## Methods

To determine if adequate versus inadequate prenatal care affected maternal child outcomes and to determine which groups of women were not receiving adequate prenatal care, descriptive statistics and analytical statistics were run on birth files from Montgomery County, OH between the years of 2007-2009. Permission was received from both the Institutional Review Board from Wright State University and the Public Health – Dayton and Montgomery County, OH to complete this research.

Birth certificate files were collected from the Montgomery County Public Health Department for the years 2007-2009. Birth certificate data contained all women who gave birth

in 2007-2009 to a live infant and were residents of Montgomery County. Descriptive statistics were conducted on the following demographic categories Age, Race, Education, Payment Method, Marital Status, and WIC (Table 6). The outcomes of gestational age, birth-weight, breast-feeding upon discharge from the hospital, primary cesarean section rates, and smoking for 1st and 3rd trimester were also used as dependent variables/outcomes.

Utilizing "IF-THEN" function in Excel, Age was separated into <20, 20-34, and 35+. Any women listed as >60 years old or reported as "99" was excluded. Using the same method, Race was categorized into Caucasian, African American, and Other. Any person listed as "9" (unknown) in the data set was excluded. Education was separated into Some High School, High School Graduate, Some College, Associate's Degree, Bachelor's Degree and higher. All unknowns were excluded. Payment Method was separated into Private, Medicaid, Self Pay, and Other, again excluding any unknown. For Marital Status the number 0 in the data indicated single and 1 indicated married, these categories were re-named accordingly. For WIC Participants, the National Vital Statistics original categories of Y (yes), N (no), and U (unknown) were used, excluding the unknown. Using Pivot Tables in Excel, total number N and percents of population and demographic were calculated (Appendix A).

Adequacy of prenatal care was then analyzed. Utilizing the category labeled NPREV in the original National Vital Statistics Data, the number of prenatal visits was then categorized into <4, 4-10, and 11+ using the "IF-THEN" function in Excel. Any subject with >30 visits was excluded from the data. With this, Pivot Tables were again used to determine the number N and percent for each levels of adequacy. Utilizing Pivot Tables in Excel, 2008, each of the above listed demographics (age, race, education level, insurance payer, marital status, and WIC status) were separated among each of the three levels of prenatal care adequacy. In this regard, total

number, N, and percents were determined for how many women within each demographic received <4, 4-10, or 11+ number of prenatal care visits. From here, percent of total within each prenatal care category and percents were determined (Appendix B) using Pivot Tables in Excel, 2008. Utilizing Pivot Tables once again, the number of women within each demographic above and within each adequacy of prenatal care category were determined along with percent of total and percent of each demographic (Appendix B). Relative Risk (RR), Odds Ratios (OR) and Chi Square ($X^2$) statistical analysis were also for each demographic based on <4, 4-10, and 11+ prenatal visits (Table 12). The same methods were used to determine number of women, N, and percent within each outcome based on level of prenatal care visits (<4, 4-10, and 11+) and percent within each outcome (Appendix B). Relative Risk (RR), Odds Ratios (OR) and Chi Square ($X^2$) statistical analysis were also analyzed on each outcome based on <4, 4-10, and 11+ prenatal visits (Table 12).

Gestational age was categorized using "IF-THEN" function in Excel into <34weeks, 34-36 weeks, 37-40 weeks, 41-45 weeks, and >45 weeks. Women over 50 weeks were excluded. Next, birth weight was divided into Very Low Birth Weight (VLBW; <1500g), Low Birth Weight (LBW; <2500g), Normal Birth Weight (NBW: 2500-3999g), and High Birth Weight (HBW ≥4000g). Likelihood to breastfeed upon discharge from the hospital was originally coded as 0 and 1, which was changed with "IF-THEN" statements into corresponding "Yes, No." Planned cesarean section was also coded similarly and was changed to corresponding "Yes, No." Lastly, number of cigarettes in first trimester and number of cigarettes in third trimester were pulled. Those who reported "0" for both were coded "non-smoker." Subtraction function in Excel was used between the first trimester and third trimester to determine if a change had occurred. Women were then coded as "non smoker," "quit," "decrease," "increase," and "no

change" accordingly. Reports of equal to or greater than 60 cigarettes per day were excluded and coded "99."

An adjusted adequacy of prenatal care model was then formed in attempt to control for those infants who did not receive adequate prenatal care because they were born <37 weeks of gestation, but had received adequate prenatal care for their corresponding gestational age. Infants less than 34 weeks were removed as the number born below 34 weeks was only 4% of the total births and these births were likely complicated due to extreme prematurity. Those who were exactly 34 weeks were coded "adequate" if they had received ≥ 9 prenatal care visits and were coded "inadequate" if they received <9 visits. Similarly, women who delivered 35-36 weeks were coded as adequate if they had ≥10 prenatal care visits and inadequate if they had <10 visits. Women who delivered at 37 weeks were adequate if they had ≥11 prenatal visits and inadequate with <11 prenatal visits. Women who delivered at 38 weeks were adequate ≥12 prenatal visits, women who delivered at 39 weeks were adequate at ≥ 13 visits and women who delivered at 40 weeks were adequate at ≥14 visits (Table 2). Births over 40 weeks gestation were removed from the data set. This was then termed the "adjusted adequacy of prenatal care model (Adjusted APNC)" while the previous model of <4 visits, 4-10 visits, and 11+ visits (regardless of gestational age) was termed the "unadjusted adequacy of prenatal care model (Unadjusted APNC)." Descriptive data tables (chi square and odds ratios) were generated for each adequacy of prenatal care category for outcome (prematurity, birth weight, likelihood to breastfeed, planned cesarean section, and smoking cessation, Table 12).

Coding for logistical regression was completed for each outcome. The Adjusted APNC model was used as independent variable 1 and coded as "AdequatePrenatalADJ," yes/no. Age was coded as <20, 20-34, and advanced maternal age (AMA) ≥35, yes/no. Education Level was

coded as at least high school diploma, yes/no. Race was African American (AA), yes/no, and "others" were removed from the data. Payment method was coded Private, yes/no. Marital status was coded married, yes/no and WIC participant was coded yes/no. Dependent variables were gestational age, excluding <34 weeks and >40 weeks, coded as prematurity <37weeks, yes/no, birth weight, excluding HBW babies (≥4000g), coded as low birth weight, yes/no, likelihood to breast feed yes/no, planned cesarean section, yes/no, and smoking cessation, excluding all non-smokers, yes/no. Unknowns were also included (Table 6). Logistical regression was run using SPSS (need citation) for the following data sets:

- Dependent Variables: 1) Gestational Age, 2) Birth Weight, 3) Breastfeeding, 4) Planned C Section, 5) Quit Smoking.
- Independent Variables: Adequate Prenatal CareADJ+ Teens (<20) + AMA>=35 + AA Race + HS Education+Private Ins+Marital Status+WIC+Unknown.

**Table 6.** ***Explanation of all Parameters Used, Levels of Measurement, and Exclusions***

| Parameter | Natality File Category Name | Natality File Definition | Level of Measurement | Exclusions |
|---|---|---|---|---|
| **Maternal Age** | MOM_AGE | Mothers calculated age from her birth date and child's birthdate | <20<br>20-34<br>35+ | Any woman listed over age of 60 was excluded |
| **Maternal Race** | MOM_RACE | Mother's bridged race code | White<br>African American (Black)<br>Other= Native American, Chinese, Japanese, Hawaiian, Filipino, Other Asian or Pacific Islander, and Other Non-White | Files containing "9" were excluded |
| **Mother's Education Level** | MEDU | Mother's Reported Education | High school, no diploma<br>High School Degree<br>Some College, no diploma<br>Associate's Degree<br>Bachelor's Degree or higher | Files containing "9" were excluded |
| **Payment Method for Delivery** | PAY | Principal source of Payment for this delivery | Private Insurance<br>Medicaid<br>Self Pay<br>Other | Files reported "9" were excluded |
| **Mother's Marital Status** | MSTAT | Mother's reported marital status at delivery | 1= Married<br>2= Single | |
| **WIC Status** | WIC | Did Mother get WIC Food for Herself? | Y= Yes<br>N= No | Files reported U= Unknown were excluded |
| **Number of Prenatal Care Visits** | NPREV | Total Number of Prenatal Care Visits | <4<br>4-10<br>11+ | Files reporting any number ≥30 were excluded<br>For logistical regression, files reporting >20 were excluded. |
| **Gestational Age** | COMB_GEST | Combined estimate of gestation (edited from calculated gestation and clinical gestation) | <34 weeks<br>34-36 weeks<br>37-40 weeks<br>41-45 weeks<br>>45 weeks | Files reporting "99" were excluded. For logistical regression, any report >50 weeks was excluded.<br>For logistical regression, < 34 and >40 weeks were excluded. |
| **Birth weight** | WEIGHT | Birth weight in grams of infant. If weight <227 or >8165 grams then edited to 9999 | VLBW= <1500g<br>LBW= <2500g<br>NBW= 2500g-3999g<br>HBW= ≥4000g | Files with 9999 were excluded from demographics<br>For regression, all babies ≥4000g were excluded.<br>For logistical regression, ≥4000g was excluded. |
| **Breastfeeding at Discharge** | BFED | Is Infant Being Breastfed at discharge? | Y= Yes<br>N= No | Files reporting U= unknown were excluded |
| **Cesarean Section** | DEL_METH_PCS | Method of delivery primary C-section indicator | 1 if method reported= Yes<br>0 if method not reported= No | Files reporting U= Unknown were excluded |
| **Smoking in First Trimester** | CIGFN | Number of Cigarettes Smoked in 1st 3 months | Continuous Data | Files reported any number over "60" were excluded |
| **Smoking in Third Trimester** | CIGLN | Number of Cigarettes Smoked in third trimester | Continuous Data | Files reported any number over "60" were excluded |

# Results

## Descriptive Results

In Montgomery County, OH between the years 2007 and 2009 there were 21,449 live births. Of these women, 12% were teenagers, 78% were between ages 20-34, and 10% were over age 35. Sixty nine percent classified themselves as white, 28% as African American, and the remaining 3% were "other" (including Asian, Pacific Islander, Asian Indian and Native American). Furthermore, 19% had not graduated high school, 27% claimed a high school diploma and another 24% had "some college." Another 9% had an Associates degree and 22% had a bachelors degree or higher. Forty- five percent claimed Medicaid for payment of prenatal care and delivery, 46% had private insurance, 5% were self pay, and 4% were "other" (including other Tricare and other governmental subsidiary). Half of the women delivering between years 2007 and 2009 (50%) were married and 50% were not. Of the total 21,499 live births, 45% of the mother's claimed WIC benefits (Table 7) (Appendix A).

**Table 7.** ***Demographics of Women who Delivered a Live Baby in Montgomery Co., OH, 2007-2009***

| **Demographic** | **Total N** | **%** |
|---|---|---|
| **All Births 2007-2009** | 21449 | |
| **Age** | | |
| <20 | 2673 | 12 |
| 20-34 | 16641 | 78 |
| >35 | 2135 | 10 |
| **Total** | **21449** | |
| Unreported | 0 | |
| | | |
| **Race** | | |
| Caucasian | 14891 | 69 |
| African American | 6006 | 28 |
| Other | 552 | 3 |
| **Total** | **21449** | |
| Unreported | 0 | |
| | | |
| **Education (Highest Level)** | | |
| Some High School, No Diploma | 4046 | 19 |
| High School Graduate | 5798 | 27 |
| Some College, No Degree | 5119 | 24 |
| Associates Degree | 1824 | 9 |
| Bachelor's Degree or Higher | 4628 | 22 |
| **Total** | **21415** | |
| Unreported | 34 | |
| | | |
| **Payment Method** | | |
| Private Insurance | 9838 | 46 |
| Medicaid | 9459 | 45 |
| Self Pay | 1025 | 5 |
| Other (Incl. Tricare) | 905 | 4 |
| **Total** | **21227** | |
| Unreported | 222 | |
| | | |
| **Marital Status** | | |
| Single | 10804 | 50 |
| Married | 10645 | 50 |
| **Total** | **21449** | |
| Unreported | 0 | |
| | | |
| **WIC Participant** | | |
| Yes | 9518 | 45 |
| No | 11869 | 55 |
| **Total** | **21387** | |
| Unreported | 62 | |

Table 8 illustrates that in Montgomery County, OH between 2007-2009, 69% (14,679) of the women had adequate prenatal care (defined as 11 or more visits). Furthermore, 27% (5,810

women) had moderately inadequate prenatal care (between 4-10 visits). Another 3% (660 women) had very inadequate care, <4 visits (Appendix A). For those women who received adequate prenatal care, defined as 11+ visits, 12% were teenagers and 76% were aged 20-34. Seventy two percent were Caucasian and 25% were African American. Eighty three percent had at least graduated from high school and 32% claimed to have some form of college degree. Furthermore, 49% had private insurance vs. 41% who claimed Medicaid as their primary payer. For women receiving adequate prenatal care, 52% were married vs. 45% unmarried and 43% claimed WIC vs. 55% of those receiving adequate prenatal care did not claim WIC (Table 8; Appendix A).

Continuing down the scale of adequate prenatal care, those women who received moderately inadequate prenatal care, defined as 4-10 prenatal visits (inadequate prenatal care based on the ACOG guidelines, but more than the WHO guidelines of at least 4 visits), 78% were between the ages of 20-34, 65% were Caucasian vs. 32% African American. Twenty four percent had not graduated high school, thus 76% had at least graduated high school and 26% of those had some form of college degree. Forty one percent had private insurance vs. 50% with Medicaid. Only 44% were married vs. 56% who were not married and 46% of these women claimed WIC for themselves (Table 8) (Appendix A).

Of those women who very inadequate care, <4 prenatal care visits, 15% were teenagers and 77% were ages 20-34. Fifty percent were Caucasian and 49% were African American. Forty one percent of them had not graduated high school, 33% had a high school diploma and 90% did not have a college degree of any sort. Sixty two percent of them were on Medicaid, 80% of them were unmarried, and 42% of them received WIC (Table 8) (Appendix A).

**Table 8.** ***Demographics of Women in Montgomery Co., OH, 2007-2009 based on Adequacy of Prenatal Care; Unadjusted Adequacy of Prenatal Care Model***

| | < 4 Prenatal Visits | | | 4-10 Prenatal Visits | | | 11+ Prenatal Visits | | |
|---|---|---|---|---|---|---|---|---|---|
| **Demographic** | **N** | **% of N** | **% of Demographic** | **N** | **% of N** | **% of Demographic** | **N** | **% of N** | **% of Demographic** |
| **All Births 2007-2009** | 660 | 3 | | 5810 | 27 | | 14679 | 69 | |
| **Age** | | | | | | | | | |
| <20 | 99 | 15 | 4 | 708 | 12 | 27 | 1820 | 12 | 69 |
| 20-34 | 510 | 77 | 3 | 4517 | 78 | 28 | 11344 | 76 | 69 |
| >35 | 50 | 8 | 2 | 585 | 10 | 28 | 1467 | 10 | 70 |
| **Total** | **659** | | | **5810** | | | **14631** | | |
| Unreported | | | | | | | | | |
| **Race** | | | | | | | | | |
| Caucasian | 330 | 50 | 2 | 3756 | 65 | 26 | 10589 | 72 | 72 |
| African American | 322 | 49 | 5 | 1875 | 32 | 32 | 3681 | 25 | 63 |
| Other | 7 | 1 | 1 | 166 | 3 | 31 | 361 | 2 | 68 |
| **Total** | **659** | | | **5797** | | | **14631** | | |
| Unreported | | | | | | | | | |
| **Education (Highest Level)** | | | | | | | | | |
| Some High School, No Diploma | 273 | 41 | 7 | 1388 | 24 | 35 | 2301 | 16 | 58 |
| High School Graduate | 220 | 33 | 4 | 1617 | 28 | 28 | 3874 | 26 | 68 |
| Some College, No Degree | 105 | 16 | 2 | 1280 | 22 | 25 | 3643 | 25 | 72 |
| Associates Degree | 25 | 4 | 1 | 412 | 7 | 23 | 1358 | 9 | 76 |
| Bachelor's Degree or Higher | 33 | 5 | 1 | 1095 | 19 | 24 | 3446 | 23 | 75 |
| **Total** | **656** | | | **5792** | | | **14622** | | |
| Unreported | 3 | | | 18 | | | 9 | | |
| **Payment Method** | | | | | | | | | |
| Private Insurance | 111 | 17 | 1 | 2379 | 41 | 24 | 7224 | 49 | 74 |
| Medicaid | 396 | 62 | 4 | 2865 | 50 | 31 | 6031 | 41 | 65 |
| Self Pay | 124 | 19 | 12 | 356 | 6 | 35 | 530 | 4 | 52 |
| Other (Incl. Tricare) | 12 | 2 | 1 | 147 | 3 | 17 | 726 | 5 | 82 |
| **Total** | **643** | | | **5747** | | | **14511** | | |
| Unreported | 16 | | | 63 | | | 120 | | |
| **Marital Status** | | | | | | | | | |
| Single | 525 | 80 | 5 | 3271 | 56 | 31 | 6812 | 45 | 64 |
| Married | 134 | 20 | 1 | 2539 | 44 | 24 | 7819 | 52 | 75 |
| **Total** | **659** | | | **5810** | | | **14631** | | |
| Unreported | 0 | | | 0 | | | 0 | | |
| **WIC Participant** | | | | | | | | | |
| Yes | 278 | 42 | 3 | 2655 | 46 | 24 | | | |
| No | 378 | 58 | 2 | 3129 | 54 | 17 | | | |
| **Total** | **656** | | | **5784** | | | | | |

Viewed from a demographic point of view, 4% of teenagers had <4 prenatal care visits, 27% had between 4-10 visits, and 69% had 11+ visits. Similarly, for women who were aged 20-

34, 3% had <4 visits, 28% had between 4-10 prenatal care visits, and 69% had adequate prenatal care. For women 35 and over, 2% had <4 visits, 28% had between 4-10 visits, and 70% had adequate prenatal care (Appendix A).

Two percent of Caucasian women had <4 prenatal care visits, 26% had between 4-10, and 72% had adequate prenatal care. For African American women, 5% had <4 prenatal care visits, 32% had between 4-10 visits, and 63% had adequate prenatal care (Appendix A). It was found that Caucasian woman were significantly more likely to have received adequate prenatal care vs. African American women ($X^2$=179.3, p<0.0001) (Table 11).

Seven percent of women who had not graduated from high school had <4 prenatal care visits, 35% had between 4-10 visits, and 58% had adequate prenatal care (Appendix A). For those women who had a high school degree or higher, 2.2% had <4 prenatal care visits, 25% had between 4-10 visits, and 71% had adequate prenatal care (Appendix B). Women who had less than a high school diploma showed a significant difference in receiving adequate prenatal care than women with a high school education or higher ($X^2$=179.2; p<0.0001) and women who received some form of college degree also had a significantly higher chance of having adequate prenatal care than those with less education ($X^2$=155.9; p<0.0001) (Table 11).

For those women with private insurance, 1% had <4 prenatal care visits, 24% had between 4-10 visits, and 74% had adequate prenatal care visits. For those women on Medicaid, 4% had <4 prenatal visits, 31% had between 4-10 visits, and 65% had adequate prenatal care (Appendix A). The difference between women with private insurance and those with Medicaid receiving adequate prenatal care was significant ($X^2$=201.2; p<0.0001) (Table 11).

Single women received significantly less adequate prenatal care, 64%, vs. 75% of married women ($X^2$= 263.14, p< 0.0001) (Table 11). Lastly, 69% of women who received WIC

support had adequate prenatal care vs. 70% of those women who did not receive WIC who also had adequate prenatal care ($X^2$=4.467; p=0.0346) (Table 11).

**Table 11.** ***Chi Square and Odds Ratios for Demographic Data***

| Demographic | $X^2$ Value | OR | Confidence Interval | P-value |
|---|---|---|---|---|
| **Age** | | | | |
| <20 | 0.207 | 0.999 | 0.91-1.10 | 0.992 |
| 20-34 | | 1.00 | | |
| >35 | 0.194 | 1.024 | 0.93-1.13 | 0.66 |
| | | | | |
| **Race** | | | | |
| Caucasian | 179.3 | 1.56 | 1.45-1.65 | <0.0001 |
| African American | | 1.00 | | |
| | | | | |
| **Education (Highest Level)** | | | | |
| No High School Diploma | 293.79 | 0.54 | 0.51-0.58 | <0.0001 |
| High School Diploma or more | | 1.00 | | |
| | | | | |
| College Degree | 155.9 | 1.53 | 1.43-1.63 | <0.0001 |
| No College Degree | | 1.00 | | |
| | | | | |
| **Insurance Payer** | | | | |
| Private | 201.0 | 1.57 | 1.47-1.67 | <0.0001 |
| Medicaid | | 1.00 | | |
| | | | | |
| **Marital Status** | | | | |
| Married | 263.14 | 1.63 | 1.54-1.73 | <0.0001 |
| Not Married | | 1.00 | | |
| | | | | |
| **WIC Status** | | | | |
| Yes | 4.467 | 0.94 | 0.88-0.99 | 0.0346 |
| No | | 1.00 | | |

## Outcome Results

To determine if adequacy of prenatal care affected maternal child health outcomes of gestational age (prematurity), birth weight, breastfeeding rates at discharge from the hospital, risk of planned cesarean section, and smoking cessation were evaluated. These five outcome results are described below and were analyzed using logistic regression.

For all births, 9% of all babies were born between weeks 34-37 and 76% were born between 37-40 weeks. Seven percent of the total newborns were born at Low Birth Weight

(LBW), <2500g, and 2% were born at Very Low Birth Weight (VLBW), <1500g. Eighty-three percent were born at Normal Birth Weight (NBW) of 2500g-3999g and 8% were 4000g or more (High Birth Weight, HBW). Additionally, 67% of women leaving the hospital were breastfeeding and 33% were not breastfeeding. Twenty percent of the women (4,265 births) had planned cesarean sections. Lastly, eighteen percent of women reported smoking during the first trimester and of these, 19% claimed to reduce the number of cigarettes smoked by the third trimester, 63% did not change the amount they smoked, and 14% reported to have quit entirely (Table 16) (Appendix B).

**Table 16.** ***Total Amount of Women/Deliveries for each Outcome***

| Outcome | Total N | Percent |
|---|---|---|
| **Gestational Age** | | |
| <34 Weeks | 807 | 4 |
| 34-36 | 1820 | 9 |
| 37-40 | 16352 | 77 |
| 41-45 | 2393 | 11 |
| **Total** | **21372** | |
| Unknown | 77 | |
| | | |
| **Birthweight** | | |
| VLBW | 351 | 2 |
| LBW | 1592 | 7 |
| NBW | 17744 | 83 |
| HBW | 1750 | 8 |
| **Total** | **21437** | |
| Unknown | 12 | |
| | | |
| **Breastfeeding at Discharge** | | |
| Yes | 13984 | 67 |
| No | 6936 | 33 |
| **Total** | **20920** | |
| Unknown | 529 | |
| | | |
| **Planned Cesarean Section** | | |
| Yes | 4265 | 20 |
| No | 17184 | 80 |
| **Total** | **21449** | |
| Unknown | 0 | |
| | | |
| **Smoking Cessation** | | |
| Non Smoker | 17520 | 82 |
| Quit | 541 | 3 |
| Decreased Amt | 735 | 3 |
| No Change | 2482 | 12 |
| Increased Amt | 133 | 1 |
| **Total** | **21411** | |
| Unknown | 38 | |

Gestational Age

For all births, 4% were delivered <34 weeks and 9% were delivered between 34-36 weeks, which is a total of 13% of all babies born premature. Seventy seven percent of all births were between 37-40 weeks and another 11% were born >40weeks (Table 16). Of those women who delivered between 34-36 weeks, a total of 5% of women received <4 prenatal visits, 35% received between 4-10 prenatal visits, and 58% had adequate prenatal care (11+ visits)

(Appendix B). Furthermore, of those women who delivered full term (37-40 weeks), 2% had <4 prenatal visits, 26% had between 4-10 prenatal visits, and 71% had adequate prenatal care (Figure 5) (Appendix B). According to the adjusted adequacy of prenatal care model, of those who received inadequate prenatal care, 5% had premature births and 95% delivered >36 weeks. Furthermore, of all women who delivered between 34-36 weeks, 69% of them had adequate prenatal care vs. 29% of those who did not (Figure 6) (Appendix C).

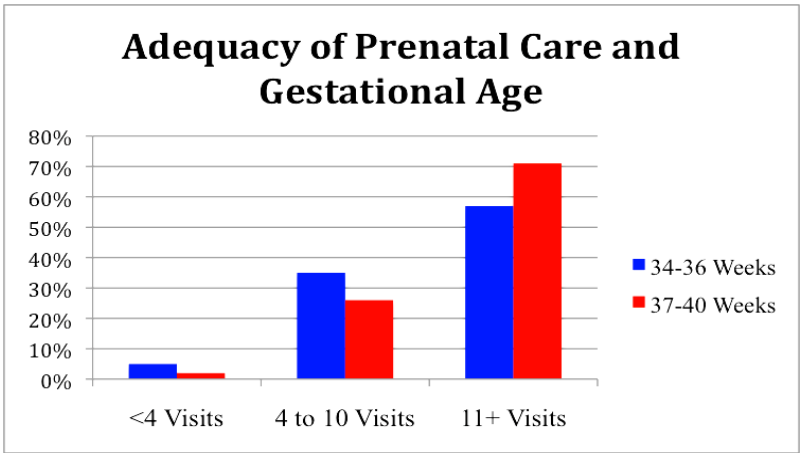


***Figure 5.*** **Adequacy of Prenatal Care by Gestational Age, Unadjusted Adequacy of Prenatal Care Model**

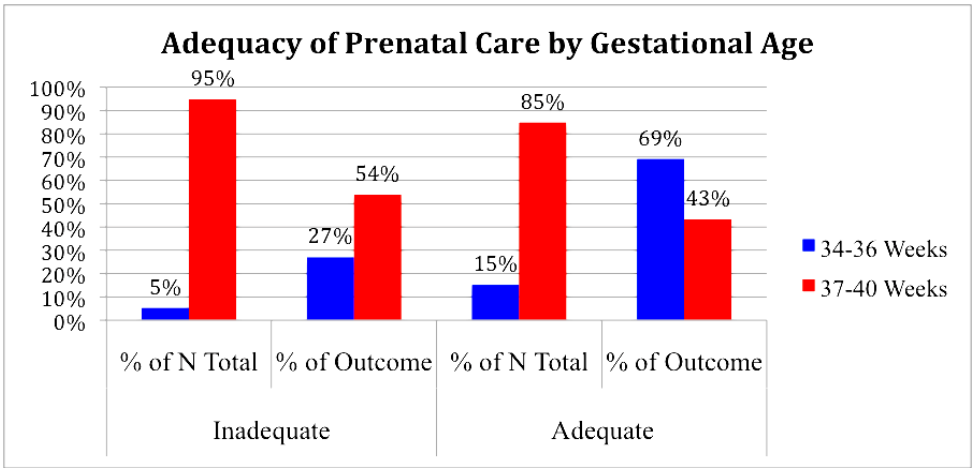


***Figure 6.*** **Adequacy of Prenatal Care based on Gestational Age based on the Adjusted Adequacy of Prenatal Care Model**
**% of N total: N= Women with adequate and inadequate prenatal care**
**% of Outcome: N= Total women per outcome (gestational age)**

According to the unadjusted adequacy of prenatal care model, the OR for delivering a premature infant with inadequate prenatal care was 1.78 (CI: 1.61; 1.97) (Table12). However, according to the adjusted adequacy of prenatal care model, the OR of delivering a premature infant with inadequate prenatal care was 0.31 (CI: 0.28; 0.35) (Table 12) (Appendix D). Utilizing the adjusted adequacy of prenatal care model and logistic regression, it was found that those women who received adequate prenatal care were 3.38 times more likely to have delivered a premature infant ($p<0.05$, CI: 3.02; 3.78) (Table 13).

Furthermore, woman at an increased risk of delivering a premature infant were women of advanced maternal age ($p<0.05$, CI: 1.26; 1.72), and being African American ($p<0.05$, CI: 1.09; 1.38). Significant protective factors to not deliver a premature infant were having a high school education ($p<0.05$, CI: 0.75; 0.94), having private insurance ($p<0.05$, CI: 0.71; 0.91), being married ($p<0.05$, CI: 0.65; 0.85), and having received WIC ($p<0.05$, CI:0.66; 0.85) (Table 13).

**Table 12.** ***Chi Square and Odds Ratio for Outcomes based on Adequacy of Prenatal Care***

| Outcome | $X^2$ Value | OR | Confidence Interval | P-value |
|---|---|---|---|---|
| **Unadjusted APNC** | | | | |
| **Gestational Age** | | | | |
| 34-36 weeks | 127.5 | 1.78 | 1.61-1.97 | <0.05 |
| >37 weeks | | 1.00 | | |
| **Adjusted APNC** | | | | |
| **Gestational Age** | | | | |
| 34-36 weeks | 475.0 | 0.31 | 0.28-0.35 | <0.05 |
| >37 weeks | | 1.00 | | |
| | | | | |
| **Unadjusted APNC** | | | | |
| **Birthweight** | | | | |
| Low Birth Weight | 170.8 | 1.89 | 1.71-2.08 | <0.05 |
| Normal Birth Weight | | 1.00 | | |
| **Adjusted APNC** | | | | |
| **Birthweight** | | | | |
| Low Birth Weight | 146.7 | 0.47 | 0.42-0.53 | <0.05 |
| Normal Birth Weight | | 1.00 | | |
| | | | | |
| **Unadjusted APNC** | | | | |
| **Breastfeeding** | | | | |
| Yes | 219.8 | 1.61 | 1.52-1.72 | <0.05 |
| No | | 1.00 | | |
| **Adjusted APNC** | | | | |
| **Breastfeeding** | | | | |
| Yes | 48.7 | 1.26 | 1.18-1.34 | <0.05 |
| No | | 1.00 | | |
| | | | | |
| **Unadjusted APNC** | | | | |
| **Planned Cesarean Section** | | | | |
| Yes | 28.1 | 1.23 | 1.14-1.32 | <0.05 |
| No | | 1.00 | | |
| **Adjusted APNC** | | | | |
| **Planned Cesarean Section** | | | | |
| Yes | 46.2 | 1.30 | 1.21-1.41 | <0.05 |
| No | | 1.00 | | |
| | | | | |
| **Unadjusted APNC** | | | | |
| **Smoking Cessation** | | | | |
| Yes | 3.48 | 1.21 | 1.00-1.46 | 0.062 |
| No | | 1.00 | | |
| **Adjusted APNC** | | | | |
| **Smoking Cessation** | | | | |
| Yes | 0.55 | 1.09 | 0.88-1.34 | 0.46 |
| No | | 1.00 | | |

Low Birth Weight

According to the adjusted adequacy of prenatal care model, 4% of babies who received inadequate prenatal care delivered a low birth weight baby and 87% delivered a normal birth weight baby. Those women who received adequate prenatal care, 9% delivered a low birth weight baby and 84% delivered a normal birth weight baby (Figure 7) (Appendix C). For all those babies born at a low birth weight, 47% of them received adequate prenatal care vs. 26% who did not.

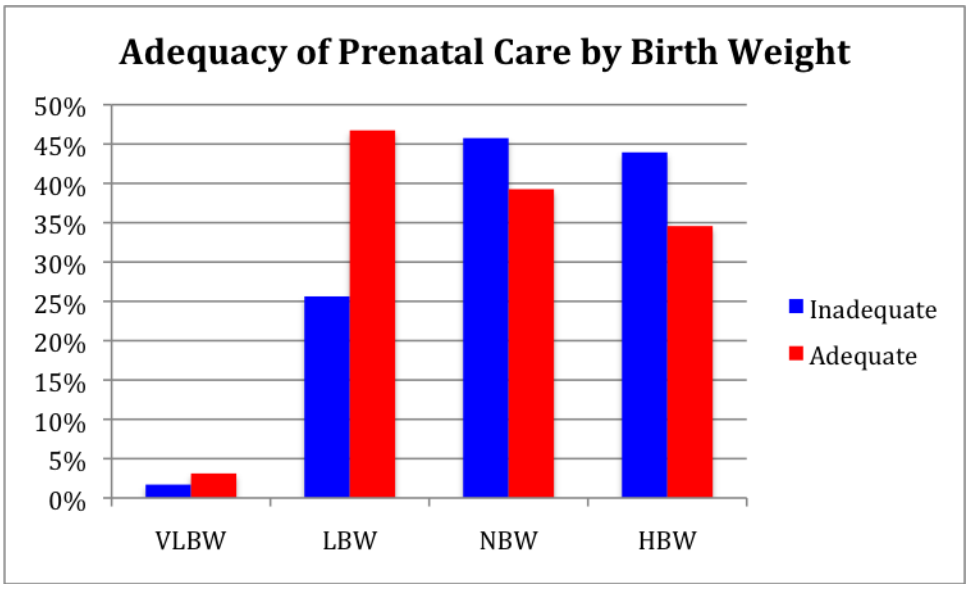


***Figure 7*. Amount of Prenatal Care by Birth Weight, Adjusted Adequacy of Prenatal Care Model**

According to the unadjusted model for adequate prenatal care, 8% and 13% of women who received 0-3 prenatal visits, had VLBW and LBW babies, respectively. Of these women who received 0-3 prenatal visits, 75% had normal birth weight babies (2500g-4000g). For women who received 4-10 prenatal visits, 3% and 9% had VLBW and LBW babies, respectively, and 81% had normal birth weight babies. Those women who received 11+ prenatal visits had 1% and 6% VLBW and LBW babies, respectively, and 84% normal birth weight

babies (Figure 8) (Appendix B). Furthermore, of those women who delivered a low birth weight infant, 6% had <4 prenatal visits, 34% had 4-10 prenatal visits, and 58% had 11+ prenatal visits.

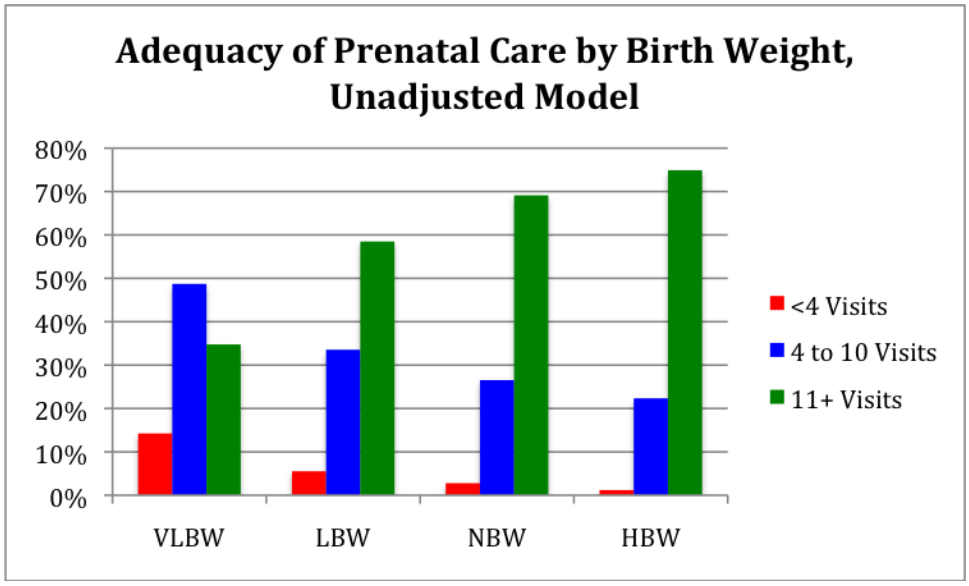


***Figure 8.*** **Amount of Prenatal Care by Birth Weight, Unadjusted Adequacy of Prenatal Care Model**

According to the unadjusted adequacy of prenatal care model, the Odds Ratio (OR) of having a low birth weight baby if received inadequate prenatal care was 1.89 (CI: 1.71; 2.08). However, according to the adjusted adequacy of prenatal care model, inadequate prenatal care was a protective factor against having a LBW baby (OR: 0.47, CI: 0.42; 0.53) (Table 12) (Appendix D). Utilizing the adjusted adequacy of prenatal care model in logistic regression, women who received adequate prenatal care were 2.34 times more likely to deliver a low birth weight baby ($p<0.05$, CI: 2.06; 2.67) (Table 13).

Utilizing logistic regression and the adjusted adequacy of prenatal care model, women of advanced maternal age were 1.67 times more likely to deliver a low birth weight baby ($p<0.05$, CI: 1.38; 2.03) and African American women were 1.43 times more likely to deliver a low birth weight baby ($p<0.05$, CI: 1.25; 1.64). Protective factors against having a low birth weight baby

were having at least a high school education (0.70; p<0.05, CI: 0.61; 0.81), having private insurance (0.69; p<0.05, CI: 0.59; 0.81), being married (0.73; p<0.05, CI: 0.62; 0.86), and marginally having received WIC (0.83; p= 0.13, CI: 0.71; 0.96) (Table 13).

Breastfeeding

The percent of women who were breast feeding upon discharge from the hospital was 29%, 63%, and 69% for women receiving 0-3 prenatal visits, 4-10 visits, and 11+, respectively (Figure 9, Appendix B). The OR of likelihood to breastfeed upon discharge from the hospital using the adjusted adequate prenatal care was 1.26 (CI: 1.18,1.34). Similar statistical significance was found for the unadjusted adequacy of prenatal care model (Table 12).

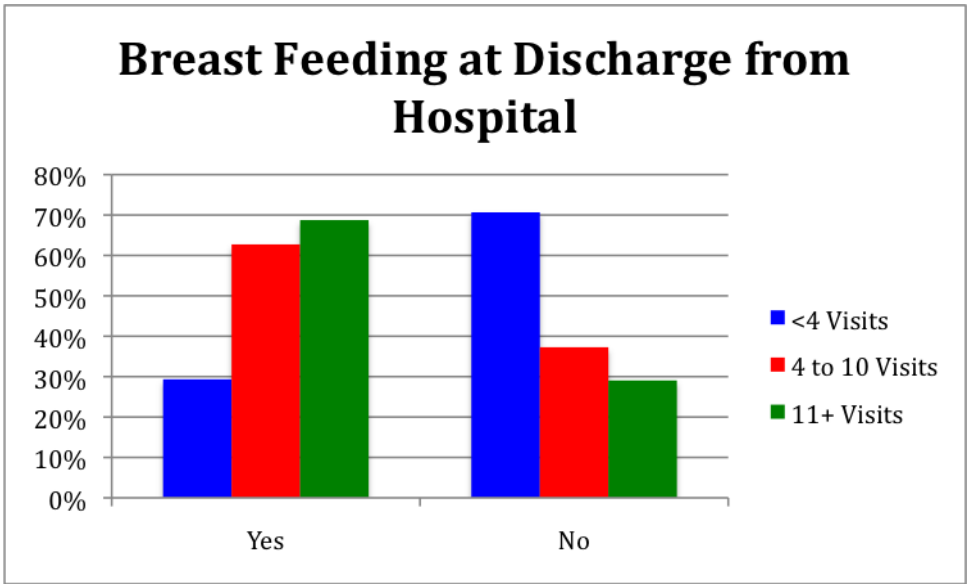


***Figure 9.*** **Breast feeding at time of Discharge from the hospital based on adequacy of prenatal care, Unadjusted Adequacy of Prenatal Care Model**

Overall, women who received adequate prenatal care, were 1.15 times more likely to be breastfeeding at time of discharge from the hospital than those who had inadequate care (p<0.05, CI: 1.07;1.2; Table 13). Teenagers were 1.2 times more likely to breastfeed upon discharge from the hospital versus women aged 20-34 (p<0.05, CI: 1.1; 1.4). Women who had received at least a high school education were 2.3 times more likely (CI: 2.13; 2.5) than women who had not

received at least a high school diploma to breastfeed (Table 13). Furthermore, women who had private insurance were 1.4 times more likely ($p<0.05$, CI: 1.3-1.6) than women with Medicaid to breastfeed and women who were married were 1.78 times more likely (CI: 1.61; 1.89) than those who were not married (Table 13).

Cesarean Section

Twenty percent of the women overall had a planned cesarean section. Of those women who planned to have a cesarean section, 72% received 11+ visits, vs. 27% who received <11 visits (Figure 11). According to the adjusted adequacy of prenatal care model, women who received adequate prenatal care were much more likely to have had a planned cesarean section (OR: 1.30, CI: 1.21; 1.31) with similar results demonstrated in the unadjusted model (Table 12). Using logistic regression and the adjusted adequacy of prenatal care model, women who had a planned cesarean section were 1.3 times more likely to have had adequate prenatal care ($p<0.05$, CI: 1.2-1.4) (Table 13).

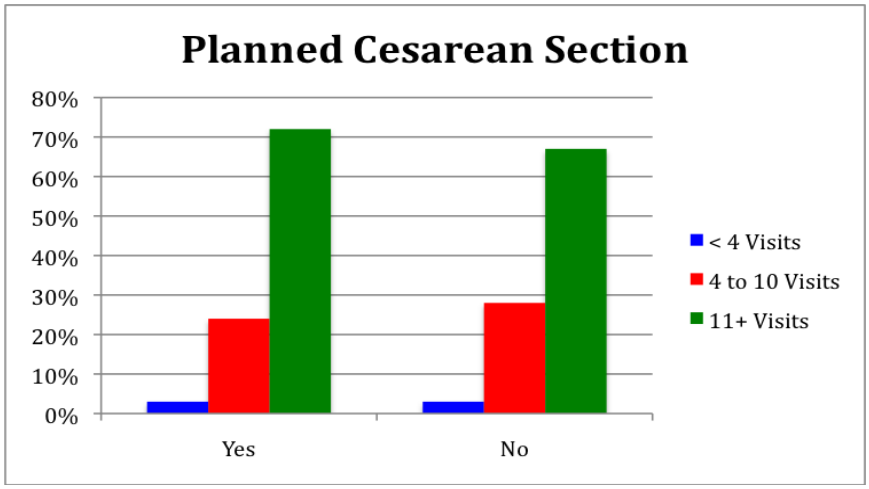


***Figure 11.*** **Percent of Women who had a Planned Cesarean Section based on Adequacy of Prenatal Care, Unadjusted Adequacy of Prenatal Care Model**

Women of advanced maternal age (<34 years) were 1.2 times more likely to have had a planned cesarean section than women aged 20-34 ($p<0.05$, CI: 1.06; 1.4), however, teenagers

were not significantly more likely (Table 13). Those women who had private insurance were 1.3 times more likely to have had a planned cesarean section ($p<0.05$, CI: 1.2; 1.5). And, women who were married had a protective factor against the risk for cesarean sections and were 0.8 times likely to have planned a cesarean section versus those women who were not married ($p<0.05$, CI: 0.72; 0.89) (Table 13).

Smoking Cessation

Of the 18% of women who reported smoking, 2% reported that they quit smoking by the third trimester of pregnancy. Twelve percent reported no change and 3% reported decreasing the amount of cigarettes they smoked by the third trimester (Appendix B). Of those who quit smoking, 3% had <4 prenatal care visits, 31% had between 4-10 visits, and 63% received adequate prenatal care (Appendix B). According to both the adjusted and unadjusted adequacy of prenatal care models, of those who received adequate prenatal care, 84% reported they did not smoke during pregnancy at all, 2% quit by the third trimester and 3% quit (Figure 10) (Appendix C).

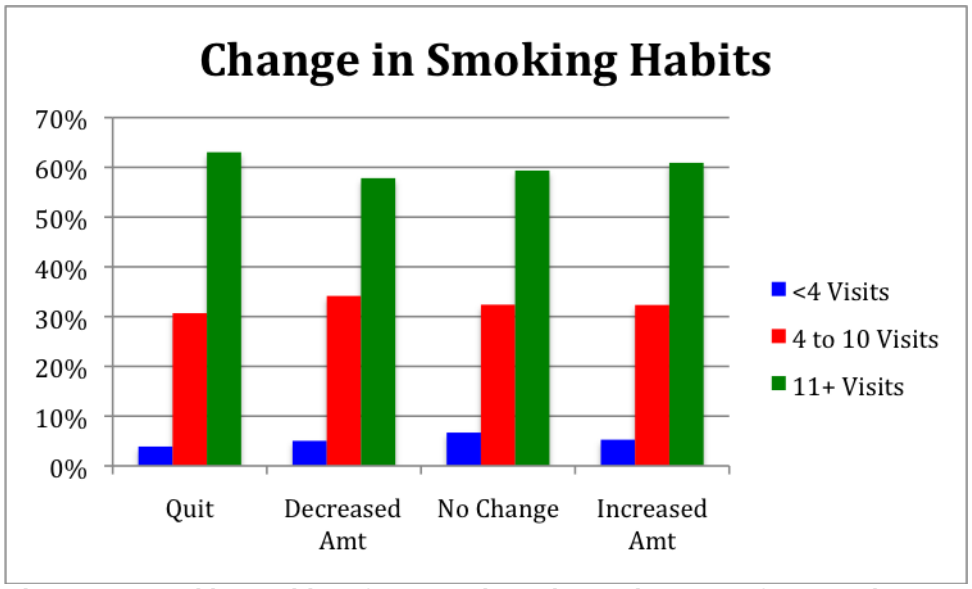


***Figure 10*. Smoking Habits of Women based on Adequacy of Prenatal Care, Unadjusted Adequacy of Prenatal Care Model**

Women who quit smoking had 1.21 greater odds to have received adequate prenatal care (unadjusted model) or 1.09 greater odds to have received adequate prenatal are (adjusted model), however neither of these were significant (CI: 1.00; 1.46 and CI: 0.88; 1.34, respectively) (Table 12) (Appendix D). Using logistic regression and the unadjusted adequacy of prenatal care model, women were 1.04 times more likely to have quit smoking if they received adequate prenatal care (p=0.731, CI0.84; 1.28), also demonstrating no statistical significance (Table 13).

Teenagers were the most likely to quit smoking, 1.9 times more likely, compared to women aged 20-24 (p<0.05, CI: 1.4; 2.6) and women >34 years old were 0.50 times as likely to quit (p<0.05, CI: 0.31; 0.81) (Table 13). Furthermore, African Americans were 1.5 times more likely to quit smoking than Caucasian women (p<0.05, CI:1.2; 2.0), women with at least a high school diploma were 2.1 times more likely to quit (p<0.05, CI: 1.7; 2.6) than those who had not graduated high school, and women with private insurance were 1.3 times more likely to quit than women with Medicaid (p<0.05, CI: 1.1; 1.8) (Table 13).

**Table 13.** ***Statistics for Logistic Regression Models***

| **Independent Variables** | Adequate PNC ADJ** | Teens | AMA | AA Race | HS Education | Private Ins | Marital Status | WIC |
|---|---|---|---|---|---|---|---|---|
| **Dependent Variables** | | | | | | | | |
| Gestational Age | 3.379* | 0.950 | 1.472* | 1.226* | 0.838* | 0.800* | 0.742* | 0.752* |
| Low Birth Weight | 2.339* | 1.095 | 1.673* | 1.429* | 0.701* | 0.688* | 0.733* | 0.831* |
| Breastfeeding | 1.152* | 1.250* | 0.903 | 0.842* | 2.303* | 1.464* | 1.877* | 0.771* |
| Planned Cesarean Section | 1.295* | 1.049 | 1.204* | 1.022 | 1.106* | 1.363* | 0.800* | 1.063 |
| Smoking Cessation | 1.038 | 1.992* | 0.501* | 1.553* | 2.099* | 1.374* | 0.976 | 0.968 |

* p<0.05
**Adjusted Adequacy of Prenatal Care Model

## Discussion

### Prenatal Care by Demographic

The distribution of women in each of the unadjusted prenatal visit categories (<4, 4-10, and 11+) was spread equally among all age groups (Table 8). Approximately 2-4% of <20 year olds, 20-34 year olds, and 35+ had <4 prenatal visits, approximately 27-28% of each age group had 4-10 visits and 69-70% of each age group had 11+ prenatal visits. This demonstrates shows no difference among age groups based for adequacy of prenatal care received ($p<0.0001$). This also coincides with the percent of total women within each prenatal visit group- 3% of the entire population had <4 prenatal care visits, 27% had 4-10 prenatal care visits, and 69% had 11+ prenatal care visits. Thus, age did not seem to be a predictor of the adequacy of prenatal care a woman received in Montgomery County, OH. This is a discrepancy compared to the US averages which have shown for years that teenage women, on average, have lower rates of receiving adequate prenatal care (Institute of Medicine, 1989; McDonald & Coburn, 1988). Furthermore, women of advanced maternal age should be receiving significantly more adequate prenatal care, as this category of women are considered "high risk." The statistics in Montgomery, County, OH does not support that these women are receiving significantly more prenatal care than women of other ages. Overall, unlike the national averages and unlike what one might expect, age does not predict adequacy of prenatal care in Montgomery County, OH.

However, unsurprisingly, the amount of women who received adequate prenatal care was directly proportional to the amount of education they received. Forty one percent of all women who received less than 4 prenatal visits had not graduated high school vs. only 9% of those women who had some form of a college degree (Table 8). Furthermore, of those women who had not graduated high school, 7% had <4 prenatal care visits, vs. only 1% of women who had some

form of college degree. To further demonstrate this, only 58% of women who had not graduated high school received 11+ prenatal care visits vs. 75% of those women who had some form of college degree (Table 8). This shows that the more education a woman received, the more likely she was to have also received adequate prenatal care during her pregnancy. Additionally, the amount of women who received inadequate prenatal care reduced gradually as education increased and the amount of adequate prenatal care increased steadily as education increased. Thus, from the data, education was directly related to receiving adequate prenatal care (Table 8), in particular, having at least a high school diploma was a significant protector from inadequate prenatal care ($X^2$=179.2; p<0.0001).

However, as stated above, age did not correlate with adequacy of prenatal care ($X^2$= .207, p= 0.999; Table 11). Therefore, it did not necessarily follow that as a woman got older she had more education. From this data, education itself was a stronger predictor of likelihood to receive adequate prenatal care than age. Nationally, age and education have a significant impact on likelihood to receive adequate prenatal care individually. However, interestingly, in Montgomery County, OH only education was significantly related to adequacy of prenatal care.

Out of the total number of women who received less than 4 prenatal visits, Caucasian and African American women were 50% and 49% of the total, respectively (Table 8). However, out of all Caucasian women, only 2% had less than four prenatal visits versus 5% of all African American women. Furthermore, out of all the women who received adequate prenatal care, 11+ visits, 72% of them were Caucasian versus only 25% of them who reported being African American. Again, solely out of the Caucasian females, 72% of them had adequate prenatal care vs. 63% of all African Americans (Table 8). Thus, more Caucasian women received adequate prenatal care than African American women ($X^2$=179.3, p<0.0001) (Table 11). Nationally, being

a minority, and in particular, African American, is a risk factor for receiving inadequate prenatal care. However, if the biological factor of being African American is the true risk, or if other variables are influential such as socioeconomic status, education, and insurance, was not determined in this study or well studied on a national level. According to this research, being African American versus Caucasian was significant correlated with inadequate prenatal care. However, it is important to note that being African American may or may not be a risk factor not based solely on race, but also may be based on other influences outside the scope of this research.

Another factor that influenced if women received adequate prenatal care was the type of insurance they carried. For those women who had less than 4 prenatal visits, 62% of them had Medicaid vs. only 17% of those with private insurance. Furthermore, 74% of women who carried private insurance received adequate prenatal care vs. 65% of women who had Medicaid (Table 8). From these numbers, women who had private insurance were clearly more likely to have had adequate prenatal care versus women on Medicaid or any other form of insurance. Nationally, since the induction of Medicaid, lower income women have been able to receive more adequate prenatal care than compared to prior years. However, from this research, women in Montgomery County, OH who received Medicaid were still significantly less likely to have received adequate prenatal care vs. women who had private insurance ($X^2$=179.3, p<0.0001) (Table 11). This corresponds to the same rates, on average, nationally, which has been documented since the 1980s.

These results may demonstrate that having private insurance allows for more detailed and adequate follow-up throughout a pregnancy, allowing for more women to receive adequate prenatal care. Or, this may be also correlated with education level. Potentially, if a woman has a

higher education, she is more likely to have a career that provides private medical insurance. Thus, it is not clear if private insurance alone affects adequacy of prenatal care or if it is correlated with education level. However, according to national averages and according to this study in Montgomery County, OH, having private insurance shows to be a protective factor against inadequate prenatal care.

Of women who received less than four prenatal care visits, 80% of them were not married vs. 20% who were married (Table 8). Of all women who were not married, 5% received <4 prenatal visits vs. 1% of those who were married. Of all the women who received adequate prenatal care, 52% of them were married vs. 45% who were not married. Additionally, 75% of the women who were married received adequate prenatal care vs. only 64% of those women who were not married (Table 8). This demonstrates, again, that in Montgomery County, OH, being married increased the chance of receiving adequate prenatal care during pregnancy ($X^2$=263.14, p<0.0001) (Table 11). This, however, does not control for the possibility that women who are married may have a higher chance of having private insurance through either her career or her partner's. Thus, it cannot be completely determined if this relationship is solely based on the marriage or if there are correlated variables. Married women may have more supportive environments, which encourage them to attend more prenatal visits and may feel more responsibility to take the better care of the child when the father is more involved. This outcome does follows with national trends which also state that being married is a protective factor for receiving adequate prenatal care.

Lastly, 69% women who received WIC also received adequate prenatal care vs. 70% of women who did not receive WIC (Table 8). Of those women who received WIC, 3% had <4 prenatal visits and for women who did not receive WIC, exactly 3% also had <4 prenatal visits

(Table 8). From the raw data this appears to show no difference between those women or do or do not receive WIC for themselves and their likelihood of also receiving adequate prenatal care. However, due to the large sample size and rounding, statistically there is actually a significant difference between the two. It is marginal protective factor to have not received WIC for also receiving adequate prenatal care ($X^2$=4.467, p=0.0346) (Table 11). Due to the relatively close numbers, one may conclude that those women receiving WIC are not drastically different, demographically, from those women who do not receive WIC. Although, the standard is low-income, of need women, the women receiving WIC today may be more educated, married women who are experiencing economic hardships in this economy and need assistance for food with WIC. Thus, although there is a marginally protective effect of not receiving WIC on receiving adequate prenatal care, the numbers are dramatically less significant than other demographics.

Overall, in Montgomery County, OH receiving adequate prenatal care was not significantly influenced by age and only moderately influenced by WIC status. However, race, education, type of insurance, and marital status had a significant effect on if the women received adequate prenatal care. Those women who were least likely to receive adequate prenatal care in Montgomery County, OH were African Americans, those who had not graduated high school, those with Medicaid, and those women who were not married. Thus, those women who were the most likely to have received adequate prenatal care were Caucasian, more highly educated, as education this was indirectly correlated with adequacy of prenatal care, to have private insurance, and to have been married.

## Outcomes

### Prematurity

Reducing the rates of premature birth should be a major focus of prenatal care visits. More than 500,000 babies (1 in 8) are born premature (<37 weeks) in the US annually. It is the leading cause of infant death and leads to life long neurological problems. If avoiding these outcomes is not enough of a desire to reduce preterm birth rates, prematurity and its complications cost the US health care system over $26 billion dollars a year (CDC, 2012a).

In 2010, the preterm birth rate in the US was 11.99% (Hamilton, Martin, & Ventura, 2011). In Montgomery County, OH between years 2007-2009 the premature birth rate was 13%, slightly higher than the national average (Table 16). Furthermore, for those women who received adequate prenatal care, according to the adjusted adequacy formula, 15% of those women had premature infants (34-36weeks) and 85% delivered between 37-40 weeks. Of those women who received inadequate prenatal care, only 5% delivered a preterm infant (34-36 weeks; Figure 6). Of all the women who delivered between 34-36 weeks, 69% of them had adequate prenatal care vs. those women who delivered between 37-40 weeks; only 43% of them received adequate prenatal care (Figure 6). The data therefore, shows that having adequate prenatal care puts a woman at a 3.37 times greater risk for having a preterm delivery ($p<0.001$, CI: 3.02;3.78) (Table 13). Furthermore, an OR of 0.31 (CI: 0.28-0.35) (Table 12) was determined for women who received adequate prenatal care to deliver a full term baby when utilizing the adjusted adequacy of prenatal care model. However, with the adjusted adequacy of prenatal care formula, it should be noted, that many more woman were considered “adequate” if they had delivered prematurely, because it is easier to reach the number of required visits when delivering prematurely than those who delivered at or past 37 weeks. Beginning after 37 weeks, adequate prenatal care requires

once weekly visits as opposed to once or twice monthly prior to 37 weeks. Thus, it seems as though receiving adequate prenatal care increases the risk of premature birth when in reality the numbers are showing that more premature babies achieved adequate prenatal care.

To attempt to overcome this issue, using the unadjusted adequacy of prenatal care model, women were considered adequate at ≥11 visits, the number required to receive adequate prenatal care at 37 weeks gestation, regardless of their true gestational age. Although this model also has its flaws, this model showed adequate prenatal care (≥11 visits) as a protective factor for being at risk of delivering a premature infant. The OR of delivering a premature infant with adequate prenatal care was 0.56 (CI: 0.51-0.62). This demonstrates that regardless of what age the baby was delivered at, receiving at least 11 prenatal visits was a protective factor against delivering a preterm infant. The evidence in the United States, however, shows that increased prenatal care is inconclusive in its ability to reduce the risk of premature birth. It has been documented, however, that prenatal care allows for premature babies to be immediately transferred to neonatal intensive care units where their chances of survival are the greatest (Goldenberg & Rouse, 1998).

Furthermore, women of African American Race and Advanced Maternal Age were at significantly higher risk for delivering a preterm baby ($p<0.05$, CI: 1.09; 1.38 and $p<0.05$, CI: 1.26; 1.72, respectively). Although women of advanced maternal age did not show a significantly higher likelihood to have received inadequate prenatal care, it was shown that African American women in Montgomery County, OH were more likely to not receive adequate prenatal care and are at a greater risk of delivering a premature infant. Nationally, it has been demonstrated that African-American women experience twice the risk of preterm delivery as white women. The reason for the disparity in preterm delivery between African-American and white women remain unexplained (Marks, 1997).

Low Birth Weight

Morbidity and mortality associated with low birth weight is difficult to separate from prematurity, however, approximately 50% of low birth weight (LBW) babies are not due to prematurity (Lopez & Choonara, 2009). The Centers for Disease Control and Prevention (CDC) indicates that from the years 1980-2000, the incidence of low birth weight babies (<2,500g) increased by 11.8% and the incidence of very low birth weight babies (<1,500g) increased by 24.3% (MMWR, 2002). The low birth weight rate in Montgomery County, OH between 2007-2009 was 9%.

According to the adjusted adequacy of prenatal care model, 4% of women who had inadequate prenatal health care also had low birth weight babies vs. 9% of those women who had adequate prenatal health care. Additionally, of all women who delivered a low birth weight baby, 26% had inadequate prenatal health care vs. 47% who had adequate care. This shows a 0.47 greater odds of having a low birth weight baby if having received adequate prenatal health care (CI: 0.42; 0.53) with the adjusted prenatal health care model. This follows a similar trend as prematurity. According to this model, more women were considered to have adequate prenatal health care if they delivered earlier, likely, because it was easier to have achieved this number vs. women who delivered full term. Additionally, it is important to note that women who seem to be at risk of having a premature and/or low birth weight baby may have had increased prenatal visits due to the high risk nature of the pregnancy, thus pushing them over into the “adequate” category more often than those pregnancies not at risk. This is inappropriately skewing these results into looking as though having had adequate prenatal health care was a risk factor for low birth weight.

Again, to attempt to overcome this concern, the unadjusted adequacy of prenatal health care model was used. Twenty one percent of women who had <4 prenatal visits had low birth weight babies vs. 7% of women who had adequate prenatal health care (11+ visits). Of all women who had a low birth weight baby, 58% had adequate prenatal health care and 40% had inadequate, overall. This corresponds to 1.89 greater odds of having a low birth weight baby if having received inadequate prenatal health care (CI: 1.71; 2.08). According to this model, having adequate prenatal health care was protective against the risk of having a low birth weight infant. Again, this corresponds to similar figures demonstrated for prematurity, as it should, given the difficulty of separating prematurity from low birth weight. Furthermore, this relationship shows the more expected outcome that having adequate prenatal care, of at least 11 visits regardless of gestational age, decreased the odds of having a low birth weight baby.

Again, following similar trends of prematurity, women who were either of advanced maternal age or African American were at a higher risk of delivering a baby of low birth weight ($p<0.05$, CI: 1.38; 2.03 and $p<0.05$, CI: 1.25; 1.64, respectively). Given the similarity of these numbers to those of prematurity, it seems as though the major risk of having a low birth weight baby is having a premature baby, as the demographics of women at risk for both either prematurity or low birth weight are the same.

Similar demographics showed protective factors against having a low birth weight baby as they did for prematurity. For example, having a high school education, having private insurance, and being married were all protective factors against having a low birth weight baby. This is expected given national averages. Having received WIC was marginally protective with women who received WIC being 0.83 times more likely to have had a low birth weight baby ($p= 0.13$, CI: 0.72; 0.96), which is interesting as typically these women are of lower socioeconomic

status and are at an increased risk for low birth weight babies. However, it must be understood that the demographic of women receiving WIC is changing with the changing economy and, thus WIC has become a marginal protective factor for prematurity and low birth weight.

Overall, according to the unadjusted adequacy of prenatal health care model, women who received adequate prenatal care had 1.89 greater odds of having a normal birth weight baby (CI: 1.71; 2.08). Furthermore, risk factors for having a low birth weight baby were being of advanced maternal age, being African American, having a lower education level, having Medicaid, being unmarried, and not receiving WIC (marginally). These women should be targeted heavily on the morbidity and mortality associated with low birth weight babies.

Breastfeeding Rate

Increasing the number of women who breastfeed and in particular, exclusively breastfeed for 6 months after delivery, has been a worldwide goal. The Healthy People 2010 Initiative's goal was to have 75% of mothers initiate breastfeeding. The US breast feeding rates have been steadily increasing in the past years. However, is this due to increased education and encouragement in prenatal care visits or because of public health advertising and initiatives? In Montgomery County, OH, 70% women who received adequate prenatal care were breastfeeding upon discharge from the hospital vs. 65% of those women who did not have adequate prenatal care (adjusted adequacy of prenatal care model, Table 16, Figure 9). Only 29% of women who received <4 visits in the unadjusted model were breastfeeding at discharge, however, rates for women who received 4-10 or 11+ visits were similar to those from the adjusted model (63% and 69%, respectively). Both models showed statistical significance for increased likelihood to breastfeed at discharge if having received adequate prenatal care. For the unadjusted model, the odds of breastfeeding after discharge from the hospital if the woman had adequate prenatal care

was 1.61 (CI: 1.52; 1.72; Table 12) and according to the adjusted model the odds of a woman breastfeeding who received adequate prenatal care was 1.26 (CI: 1.18; 1.34) (Table 12). According to the literature, it has also been demonstrated that prenatal classes significantly improved the likelihood that a woman breastfeeds after delivery. It has been documented that 86.8% of women who attended prenatal classes intended to breastfeed (half of whom intended to breastfeed for at least 1 year) vs. only 27.0% of women who did not attend prenatal classes ($p=0.0028$) (Kervin, Kemp, & Pulver, 2010).

In Montgomery County, OH between the years 2007-2009 those women who received adequate prenatal care were significantly more likely to be breastfeeding upon discharge from the hospital. This is a great achievement of the health care field, as breastfeeding is significantly healthier for the infant vs. bottle-feeding. As stated previously, it is estimated that if 90% of pregnant women initiated and sustained breastfeeding for 6 months in the US, it would save $13 billion per year and 911 infant lives (Bartick & Reinhold, 2010). Thus, this improvement in initiation of breast-feeding that has been accomplished needs to continue.

Furthermore, having received at least a high school education ($p<0.05$, CI: 2.31; 2.49), having private insurance ($p<0.05$, CI: 1.31; 1.60), and being married ($p<0.05$, CI: 1.72; 2.05) all demonstrated an increased likelihood to breastfeed (Table 13). African American women were 0.84 times less likely to breast feed compared to Caucasian women ($p<0.05$, CI: 0.78; 0.91). Women who received WIC were 0.77 times less likely to breast feed than women who did not receive WIC ($p<0.05$, CI: 0.71; 0.84) (Table 13). Interestingly, formula is offered through WIC and thus may be encouraging women to not breast feed, as it may not have the same economic impact on a woman receiving WIC as it does on women who do not. Additionally, the age group of women most likely to breastfeed were teenagers. They were 1.25 more likely to breast feed

than woman aged 20-34 ($p<0.05$, CI: 1.13; 1.39) (Table 13). This relationship is not well understood and does not seem to follow national trends reported by the CDC which state that women over age 30 breastfeed significantly more than younger women (2008). Potentially, teenagers in Montgomery County, OH are more influenced by the benefits of breastfeeding, have more time to breastfeed than older (possibly working) mothers, or realize the economic burden of bottle-feeding and have less ability to afford it.

Cesarean Section Rate

Cesarean section rates, for no indicated reason, have been continuously rising in western cultures for the past 10 years. Although cesarean sections have saved thousands of infant lives over the years when they are indicated, cesarean sections pose a health risk to both the mother and infant if there is no indicated reason. Cesarean Sections are linked to a multitude of poor infant and maternal outcomes including a neonatal mortality rate 2.4 times higher in women who had cesarean sections with no medical risk factors and had an adjusted odds ratio for neonatal mortality of 1.69 (95% CI: 1.35-2.11) (MacDorman et al., 2008a). These risks are only acceptable if the risk of the mother delivering the baby vaginally outweighs these numbers. However, clearly it should never be the goal of physicians to promote cesarean sections for no indicated risk.

In Montgomery County, OH, 20% of women who received adequate prenatal care based on the unadjusted model (11+ visits) had a planned cesarean section (Table 12). Those who had <4 visits and 4-10 visits both had cesarean section rates of 18%. Furthermore, of those women who had a planned cesarean section, 72% of them received adequate prenatal care vs. 67% of those women who did not have a planned cesarean section. The odds of having received a cesarean section if having adequate prenatal care were 1.23 (CI: 1.14; 1.32) (Table 12). The

adjusted adequacy of prenatal care model showed similar results, with a statistically significant increased odds of receiving a cesarean section with adequate prenatal care. According to this model, women who had a planned cesarean section were 1.30 times more likely to have had adequate prenatal care ($p<0.05$, CI: 1.20; 1.40) (Table 13). Aron et al. (2000) demonstrated that in the US women with private insurance had the highest rate of cesarean section rates, measuring 17% vs. 14.2% and 10.7% for government insurance and uninsured respectively. Furthermore, women with private insurance were more likely to have received adequate prenatal care.

It must be considered that although these women had a "planned cesarean section," the actual number of them that were for medically indicated or un-indicated reasons is unknown. However, the type of women who received planned cesarean sections are almost the exact opposite of those women who were more likely to have had a premature infant or a low birth weight baby and more closely match the demographics of women who were more likely to have received adequate prenatal health care. Women of advanced maternal age were 1.2 times more likely to have had a planned cesarean section vs. women aged 20-34 ($p<0.05$, CI: 1.06; 1.36) (Table 13). In addition, women with a high school education were 1.12 times more likely to have received a planned cesarean section than those women without ($p<0.05$, CI:1.01; 1.21) (Table 13). Being married was a significant protective factor for not having a cesarean section ($p<0.05$, CI: 0.72; 0.89) (Table 13). Most interestingly, women with private insurance were the most likely to have received a planned cesarean section. They were 1.36 times more likely ($p<0.05$, CI: 1.23-1.51) (Table 13). Overall, the women who were mostly likely to have had a planned cesarean section were women who were older, received adequate prenatal care, had a higher education, and carried private insurance. Aside from women of advanced maternal age, the rest

of these factors should increase the likelihood of having a healthy pregnancy and thus should decrease the risk of having a planned cesarean section.

Having private insurance increases the chance for a planned cesarean section the most. It is possible that these women ask for planned cesarean sections, as they are likely to be employed and need to schedule their delivery for career purposes. However, it needs to be addressed if this is an appropriate rationale for putting both the woman and infant at a risk for increased morbidity and mortality.

In a survey of over 1,600 women by Declercq, Sakala, Corry, and Applebaum (2006), women over a quarter of the women who received a cesarean section felt they were pressured by health professionals to have the procedure. Furthermore, Medicaid pays almost $5,000 more for a cesarean section than a vaginal birth and most private insurance companies reimburse many times more (McConnell, 2009). Thus, the incentive of money and false perception of the low risks of cesarean sections may be fueling the increase in un-indicated cesarean sections, particularly in women with private insurance. Furthermore, although in Montgomery County, OH there seems to be an increased risk for women of advanced maternal age, which are a higher risk group of women, nationally the increase in planned cesarean section rates is among all ages and demographics equally.

Smoking

Smoking during pregnancy has been identified as the most important potentially preventable cause of low birth-weight in the United States. It is estimated that perhaps 25 percent of low birth-weight in the United States can be attributed to maternal smoking (Marks, 1997). As it has already been demonstrated, low birth weight leads to significant increases in infant

morbidity and mortality rates. Furthermore, smoking exposure alone increases and infants risk of ear infections, asthma, SIDS, and other complications.

Although difficult, smoking cessation support and therapy (medical, if indicated) should be implemented at every prenatal visits for those women who smoke. In Montgomery County, OH, 18% of women reported smoking during their pregnancy (Table 16). This is significantly higher than the national average reported in 2005 of 13.8% (CDC, 2009). Interestingly, in this same report by the CDC it was found that Ohio was one of only three states that reported between the years 2000-2005, an increase in the number of women who smoke during pregnancy. According to another study in 2005, the number of women who reported smoking during pregnancy was 22.5% (Judge, 2009). It is clear that the number of women who actually report smoking during pregnancy varies widely across the nation. At a rate of 18%, Montgomery County fits within these two reported national statistics. However, all data may be lower than the real numbers, as women likely do not want to admit to smoking during pregnancy.

Of those women in Montgomery County, OH who reported smoking, only 3% reported quitting smoking during their pregnancy and another 3% reported decreasing the amount of cigarettes smoked (Figure 10). Twelve percent admitted to no change throughout the duration of the pregnancy. Two to three percent admitted to quitting smoking no matter the amount of prenatal care received or the model of adequacy used. The odds of quitting smoking if having received adequate prenatal care were insignificant in both models (Table 12). Furthermore, logistical regression showed a 1.04 times increase of quitting smoking if having received adequate prenatal care, however this also did not demonstrate statistical significance, (p= 0.73, CI: 0.83; 1.28) (Table 13).

Those women who did quit smoking were 1.9 times more likely to have been teenagers ($p<0.05$, CI: 1.42; 2.6), 2.1 times more likely to have been African American ($p<0.05$, CI: 1.21; 1.99), 2.09 times more likely to have received at least a high school education ($p<0.05$, CI: 1.67; 2.65), and 1.37 times more likely to have had private insurance ($p<0.05$, CI: 1.05; 1.79) (Table 13). Thus, certain demographics of women understand the risks associated with smoking during pregnancy and make and attempt to quit. However, the results are low and the affect of adequate prenatal care at increasing these numbers is insignificant. As mentioned previously, it has been documented that the utilization of medical therapy for smoking cessation may be the next step, as verbal counseling in prenatal care visits is not adequate to prevent relapse during the pregnancy or immediately thereafter. Regardless, given the amount of women who smoke during pregnancy and the demonstrated health risks bestowed upon the child due to this habit, all available time and resources should be used to encourage women to quit smoking during pregnancy. However, either this is not occurring or the efforts being used are not making a difference.

## Conclusion

Overall, the demographics of women in Montgomery County, OH least likely to have received adequate prenatal care were African American, less educated, and those without private insurance. Understanding this is advantageous so that these women may be targeted more precisely with public health measures to increase the awareness of the necessity of receiving adequate prenatal health care.

Furthermore, reporting the affect of adequate prenatal health care on prematurity and low birth weight was difficult, as all three are interrelated. Utilizing the adjusted prenatal care model was an attempt to account for this difficulty, which demonstrated that adequate prenatal health care was actually a risk factor for both prematurity and low birth weight. It seems in actuality,

that those women who delivered premature and/or low birth weight babies were more likely to have received adequate prenatal health care versus the idea that having received adequate prenatal health care was a risk factor. Therefore, it was advantageous for these women to have received adequate prenatal care, as it likely allowed for more immediate transfer to neonatal intensive care units and gives the baby the greatest chance at survival. Thus, although the results seemed to be inconclusive it would still be encouraged after this study to recommend adequate prenatal health care to woman without the fear that it actually imposed a risk to the women. It gave the opportunity for those women who were at risk to receive the best care and chances of survival for themselves and their babies.

Breastfeeding rates were consistently increased among woman with adequate prenatal care, and thus the prenatal care visits should continue to encourage this method of feeding as a benefit for both the mother and baby. The increased risk of cesarean sections for woman with increased prenatal care visits, and in particular those woman with private health insurance, is an issue that must be much more clearly analyzed. It is inappropriate for physicians to be encouraging women to have cesarean sections without an indicated reason, as this clearly increases the risk versus benefit for both the mother and the baby. Lastly, smoking cessation must be targeted more strongly in the pregnant population and the utilization of medical interventions for quitting smoking must be further evaluated.

## References

Al-Doghether, M., Al-Tuwijri, A., & Khan, A. (2007). Obstacles to preventive intervention. do physicians' health habits and mind-set towards preventive care play any role? *Saudi Medical Journal, 28*(8), 1269-1274.

Alexander, G. R., & Kotelchuck, M. (2001). Assessing the role and effectiveness of prenatal care: History, challenges, and directions for future research. *Public Health Reports, 116,* 306-316.

Alexander, G. R., & Kotelchuck, M. (1996). Quantifying the adequacy of prenatal care: A comparison of indices. *Public Health Reports (Washington, D.C.: 1974), 111*(5), 408-418; discussion 419.

American Congress of Obstetricians and Gynecologists. (2011, 01 01). *Scope of Services for Uncomplicated Obstetric Care.* Retrieved 05 20, 2011, from American Congress of Obstetricians and Gynecologists: http://www.acog.org/publications/guidelinesForPerinatalCare/gpc-371.pdf

American Pregnancy Association. (2012). *Statistics.* Retrieved April 6, 2012, from http://www.americanpregnancy.org/main/statistics.html

Aron, D.C., Gordon, H. S., DiGiuseppe, D. L., Harper, D. L., & Rosenthal, G. E. (2000). Variations in risk-adjusted cesarean delivery rates according to race and health insurance. *Medical Care, 38*(1), 35-44.

Behrman, R. & Butler, A. (2001). Institute of Medicine (US) Committee on Understanding Premature Birth and Assuring Healthy Outcomes. (Ed.). (2007). *Preterm birth: Causes, consequences, and prevention*. Washington D.C.: The National Academies Press.

Carroli, G., Rooney, C., & Villar, J. (2001). How effective is antenatal care in preventing maternal mortality and serious morbidity? an overview of the evidence. *Paediatric and Perinatal Epidemiology, 15(Suppl 1)*, 1-42.

Carroli, G., Villar, J., Piaggio, G., Khan-Neelofur, D., Gulmezoglu, M., Mugford, M., . . . WHO Antenatal Care Trial Research Group. (2001). WHO systematic review of randomised controlled trials of routine antenatal care. *Lancet, 357*(9268), 1565-1570. doi:10.1016/S0140-6736(00)04723-1

Centers for Disease Control and Prevention. (2008). *Publications and information products- NCHS data brief.* Retrieved April 30, 2012, from http://www.cdc.gov/nchs/data/databriefs/db05.htm

Centers for Disease Control and Prevention. (2009). *MMWR: trends in smoking before, during, and after pregnancy --- pregnancy risk assessment monitoring system (PRAMS), united states, 31 sites, 2000--2005.* Retrieved April 30, 2012, from http://www.cdc.gov/mmwr/preview/mmwrhtml/ss5804a1.htm

Centers for Disease Control and Prevention. (2010, 01 19). *NCHS Data Brief Number 5, April 2008 Breastfeeding in the United States: Findings from the National Health and Nutrition Examination Survey, 1999-2006*. Retrieved 05 21, 2011, from CDC Home: http://www.cdc.gov/nchs/data/databriefs/db05.htm

Centers for Disease Control and Prevention. (2012a). *Reproductive health, preterm birth.* Retrieved April 8, 2012, from http://www.cdc.gov/reproductivehealth/maternalinfanthealth/PretermBirth.htm

Centers for Disease Control and Prevention. (2012b). *FastStats- births and natality.* Retrieved March 15, 2012, from http://www.cdc.gov/nchs/fastats/births.htm

Clayton, P. E., Cianfarani, S., Czernichow, P., Johannsson, G., Rapaport, R., & Rogol, A. (2007). Management of the child born small for gestational age through to adulthood: A consensus statement of the international societies of pediatric endocrinology and the growth hormone research society. *The Journal of Clinical Endocrinology and Metabolism, 92*(3), 804-810. doi:10.1210/jc.2006-2017

Couriel, J. M. (1994). Passive smoking and the health of children. *Thorax, 49*(8), 731-734.

De Luca, R., Boulvain, M., Irion, O., Berner, M., & Pfister, R. E. (2009). Incidence of early neonatal mortality and morbidity after late-preterm and term cesarean delivery. *Pediatrics, 123*(6), e1064-71. doi:10.1542/peds.2008-2407

Declercq, E. R., Sakala, C., Corry, M. P., & Applebaum, S. (2006). *Listening to mothers II: The second national U.S. survey of women's childbearing experiences*. New York: Childbirth Connections.

Declercq, E., Menacker, F., & MacDorman, M. (2006). Maternal risk profiles and the primary cesarean rate in the united states, 1991-2002. *American Journal of Public Health, 96*(5), 867-872. doi:10.2105/AJPH.2004.052381

Dewey, K. G., Heinig, M. J., & Nommsen-Rivers, L. A. (1995). Differences in morbidity between breast-fed and formula-fed infants. *The Journal of Pediatrics, 126*(5 Pt 1), 696-702.

DiFranza, J. R., Aligne, C. A., & Weitzman, M. (2004). Prenatal and postnatal environmental tobacco smoke exposure and children's health. *Pediatrics, 113*(4 Suppl), 1007-1015.

Ferre, C., Handler, A., Hsia, J., Barfield, W. & Collins, J.W. Jr. (2011). Changing Trends in Low Birth Weight Rates Among Non-Hispanic Black Infants in the United States, 1991–2004. *Maternal and Child Health, 15*(1), 29-41.

Filion, K. B., Abenhaim, H. A., Mottillo, S., Joseph, L., Gervais, A., O'Loughlin, J., . . . Eisenberg, M. J. (2011). The effect of smoking cessation counselling in pregnant women: A meta-analysis of randomised controlled trials. *An International Journal of Obstetrics and Gynaecology, 118*(12), 1422-1428. doi:10.1111/j.1471-0528.2011.03065.x; 10.1111/j.1471-0528.2011.03065.x

Gissler, M., & Hemminki, E. (1994). Amount of prenatal care and infant outcome. *European Journal of Obstetrics & Gynecology and Reproductive Biology, 56*(1), 9-14.

Goldenberg, R., & Rouse, J. (1998). Prevention of premature birth. *New England Journal of Medicine, 339*, 313-320.

Gonzalez, R., Merialdi, M., Lincetto, O., Lauer, J., Becerra, C., Castro, R., . . . Villar, J. (2006). Reduction in neonatal mortality in chile between 1990 and 2000. *Pediatrics, 117*(5), e949-954. doi:10.1542/peds.2005-2354

Hackshaw, A., Rodeck, C., & Boniface, S. (2011). Maternal smoking in pregnancy and birth defects: A systematic review based on 173 687 malformed cases and 11.7 million controls. *Human Reproduction Update, 17*(5), 589-604. doi:10.1093/humupd/dmr022

Hamilton, B. E., Martin, J. A., & Ventura, S. J. (2011). Births: Preliminary data 2010. *National Vital Statistics Report, 60*(2), 1.

Hankins, G. D., Clark, S. M., & Munn, M. B. (2006). Cesarean section on request at 39 weeks: Impact on shoulder dystocia, fetal trauma, neonatal encephalopathy, and intrauterine fetal demise. *Seminars in Perinatology, 30*(5), 276-287. doi:10.1053/j.semperi.2006.07.009

Hussaini, S., Holley, P., & Ritenour, D. (2011). Reducing low birth weight infancy: assessing the effectiveness of the Health Start program in Arizona. *Maternal and Child Health Journal, 15*(2), 225-233.

Imdad, A., Yakoob, M. Y., & Bhutta, Z. A. (2011). Effect of breastfeeding promotion interventions on breastfeeding rates, with special focus on developing countries. *BMC Public Health, 11(Suppl 3),* S24. doi:10.1186/1471-2458-11-S3-S24

Ip, S., Chung, M., Raman, G., Chew, P., Magula, N., DeVine, D., . . . Lau, J. (2007). Breastfeeding and maternal and infant health outcomes in developed countries. *Evidence Report/Technology Assessment, (153),* 1-186.

Judge, D. (2009, July 30). Maternal smoking rates drop... A little. *Journal Watch Women's Health.*

Kaiser Family Foundation. (2009). *State health facts.* Retrieved April 7, 2012, from http://www.statehealthfacts.org/comparemaptable.jsp?ind=855&cat=2

Kervin, B., Kemp, L., & Pulver, L. (2010). Types and timing of breastfeeding support and its impact on mothers' behaviours. *Journal of Paediatrics and Child Health, 46*(3), 85-91.

Kogan, M. D., Martin, J.A., Alexander, G. R., Kotelchuck, M., Ventura, S. J., & Frigoletto, F. D. (1998). The Changing Pattern of Prenatal Care Utilization in the United States, 1981-1995, Using Different Prenatal Care Indices. *Journal of the American Medical Association, 279*(20), 1623-1628.

Kolås, T., Saugstad, O., Daltveit, A., Nilsen, S., & Øian, P. (2006). Planned cesarean versus planned vaginal delivery at term: Comparison of newborn infant outcomes. *American Journal of Obstetrics & Gynecology, 195*(6), 1538-1543.

Kotelchuck, M. (1994). An evaluation of the kessner adequacy of prenatal care index and a proposed adequacy of prenatal care utilization index. *American Journal of Public Health, 84*(9), 1414-1420.

Lawn, J. E., Wilczynska-Ketende, K., & Cousens, S. N. (2006). Estimating the causes of 4 million neonatal deaths in the year 2000. *International Journal of Epidemiology, 35*(3), 706-718. doi:10.1093/ije/dyl043

Lopez, N. B., & Choonara, I. (2009). Can we reduce the number of low-birth-weight babies? the cuban experience. *Neonatology, 95*(3), 193-197. doi:10.1159/000155649

MacDorman, M. F., Declercq, E., Menacker, F., & Malloy, M. H. (2008a). Neonatal mortality for primary cesarean and vaginal births to low-risk women: application of an "intention-to-treat" mode. *Birth, 35*(1), 3-8.

MacDorman, M. F., Menacker, F., & Declercq, E. (2008). Cesarean birth in the United States: epidemiology, trends, and outcomes. *Clinics in Perinatology, 35*(2), 293-307.

Malloy, M. H., Kleinman, J. C., Land, G. H., & Schramm, W. F. (1988). The association of maternal smoking with age and cause of infant death. *American Journal of Epidemiology, 128*(1), 46-55.

Marks, James S., M.D., M.P.H. (1997). *Testimony on infant mortality and prenatal care.* Retrieved April 10, 2012, from http://www.hhs.gov/asl/testify/t970313a.html

Martin, J. A., Hamilton, B. E., Ventura, S. J., Osterman, M. J. K., Kirmeyer, S., Mathews, T. J., & Wilson, E. C. (2011). *Births: Final data for 2009. national vital statistics report.* (No. Volume 60, Number 1). Hyattsville, MD: National Center for Health Statistics.

Mathews, T. J., & MacDorman, M. F. (2011). Infant mortality statistics from the 2007 period linked birth/infant death data set. *National Vital Statistics Reports: From the Centers for Disease Control and Prevention, National Center for Health Statistics, National Vital Statistics System, 59*(6), 1-30.

McConnell, C. (2009). *Take away the incentives for too many c-sections.* Retrieved April 10, 2012, from http://crosscut.com/2009/08/06/health-medicine/19144/Take-away-the-incentives-for-too-many-c-sections/

McDonald, T., & Coburn, A. (1988). Predictors of prenatal care utilization. *Social Science and Medicine, 7*(2), 167.

Menacker F, Declercq, E., & MacDorman, M. F. (2006). Cesarean delivery: background, trends, and epidemiology. *Semin Perinatol, 30*(5), 235-241.

Morbidity and Mortality Weekly Report, CDC. (2002). *Infant mortality and low birth weight among black and white infants --- united states, 1980--2000.* Retrieved February 29, 2012, from http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5127a1.htm

National Institute of Medicine. (1989). Summary. In *Prenatal care: Reaching mothers, reaching infants* (pp. 1). Washington DC, USA: National Academy Press.

Norton, A. (2011, 05 12). *Are C-sections fueling the obesity epidemic?* Retrieved May 21, 2011, from Reuters Health: http://www.reuters.com/article/2011/05/12/us-csections-obesity-idUSTRE74B68B20110512

Ostovar, R., Rashidian, A., Pourreza, A., Rashidi, B. H., Hantooshzadeh, S., Ardebili, H. E., . . . Members of the Panel of the Cesarean Section RAM Study. (2010). Developing criteria for cesarean section using the RAND appropriateness method. *BMC Pregnancy and Childbirth, 10*, 52. doi:10.1186/1471-2393-10-52

Queenan, J. (2011). Academy of Breastfeeding Medicine Founder's Lecture 2010: breastfeeding: an obstetrician's view. *Breastfeeding Medicine, 6*(1), 7-14.

Ramachandrappa, A., & Jain, L. (2008). Elective cesarean section: Its impact on neonatal respiratory outcome. *Clinics in Perinatology, 35*(2), 373-93, vii. doi:10.1016/j.clp.2008.03.006

Rautava, S., & Walker, W. A. (2009). Academy of breastfeeding medicine founder's lecture 2008: Breastfeeding--an extrauterine link between mother and child. *Breastfeeding Medicine : The Official Journal of the Academy of Breastfeeding Medicine, 4*(1), 3-10. doi:10.1089/bfm.2009.0004

Richards, R., Merrill, R. M., Baksh, L., & McGarry, J. (2011). Maternal health behaviors and infant health outcomes among homeless mothers: U.S. special supplemental nutrition program for women, infants, and children (WIC) 2000-2007. *Preventive Medicine, 52*(1), 87-94. doi:10.1016/j.ypmed.2010.10.010

Ruger, J. P., & Emmons, K. M. (2008). Economic evaluations of smoking cessation and relapse prevention programs for pregnant women: A systematic review. *Value in Health : The Journal of the International Society for Pharmacoeconomics and Outcomes Research, 11*(2), 180-190. doi:10.1111/j.1524-4733.2007.00239.x

Schramm, W. F. (1992). Weighing costs and benefits of adequate prenatal care for 12,023 births in missouri's medicaid program, 1988. *Public Health Reports (Washington, D.C.: 1974), 107*(6), 647-652.

Showstack, J. A., Budetti, P. P., & Minkler, D. (1984). Factors associated with birthweight: An exploration of the roles of prenatal care and length of gestation. *American Journal of Public Health, 74*(9), 1003-1008.

Stringer, M. (1998). Issues in determining and measuring adequacy of prenatal care. *Journal of Perinatology, 18*(1), 68-73.

The Partnership for Maternal, Newborn, and Child Health. World Health Organization. (2012). *Essential interventions, commodities and guidelines for reproductive, maternal, newborn and child health- executive summary.* Retrieved Jan. 29, 2012, from http://www.who.int/pmnch/topics/part_publications/201112_essential_interventions/en/index.html

US Department of Health and Human Services. (2009). *Prenatal care fact sheet.* Retrieved February 24, 2012, from http://www.womenshealth.gov/publications/our-publications/fact-sheet/prenatal-care.cfm

US Department of Health and Human Services. (2007). *Overall infant mortality rate in united states largely unchanged: Rates among black women more than twice that of white women.* Retrieved January 16, 2011, from http://www.cdc.gov/media/pressrel/2007/r070502.htm?s_cid=mediarel_r070502

Vieira, M. E., & Linhares, M. B. (2011). Developmental outcomes and quality of life in children born preterm at preschool- and school-age. *Jornal De Pediatria, 87*(4), 281-291. doi:doi:10.2223/JPED.2096

WHO Statistical Information System (WHOSIS). (2008). *Antenatal care coverage (percentage).* Retrieved February 24, 2012, from www.who.int/whosis/indicators/compendium/2008/3acf/en/index.html

Wilmink, F. A., Hukkelhoven, C. W., Lunshof, S., Mol, B. W., van der Post, J. A., & Papatsonis, D. N. (2010). Neonatal outcome following elective cesarean section beyond 37 weeks of gestation: A 7-year retrospective analysis of a national registry. *American Journal of Obstetrics and Gynecology, 202*(3), 250.e1-250.e8. doi:10.1016/j.ajog.2010.01.052

Retrieved February 12, 2012, from World Health Organization. (2008). *World health statistics, 2008*. Geneva, Switzerland: WHO Press.

World Health Organization. (2008). *World health statistics, 2008.* Geneva, Switzerland: WHO Press.

World Health Organization. (2010). *Breast feeding key to saving children's lives.* Retrieved March 6, 2012, from http://www.who.int/mediacentre/news/notes/2010/breastfeeding_20100730/en/index.html

World Health Organization. (2011). *Newborn health epidemiology.* Retrieved January 21, 2012, from http://www.who.int/maternal_child_adolescent/epidemiology/newborn/en/index.html

World Health Organization . (2011, 01 01). *Child and adolescent health and development*. Retrieved 05 21, 2011, from World Health Organization: http://www.who.int/child_adolescent_health/topics/prevention_care/child/nutrition/breastfeeding/en/index.html

World Health Organization. (2011, 01 01). *Health Topics: Pregnancy*. Retrieved 05 20, 2011, from World Health Organization: http://www.who.int/topics/pregnancy/en/

World Health Organization. (2011). *Newborn health epidemiology.* Retrieved January 21, 2012, from http://www.who.int/maternal_child_adolescent/epidemiology/newborn/en/index.html

World Health Organization. (2012). *Antenatal care- situation and trends.* Retrieved Jan. 29, 2012, from http://www.who.int/gho/maternal_health/reproductive_health/antenatal_care_text/en/

# Appendix A

**DEMOGRAPHICS OF ALL WOMEN WHO DELIVERED A LIVE BABY IN MONTGOMERY CO., OH, 2007-2009**

| | | | | ADEQUACY OF PRENATAL CARE | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TOTAL | | | <4 Visits | | | 4-10 Visits | | | 11+ Visits | | | | |
| Demographic | Number | Percent (of Reported) | | Number | Percent (of Reported) | Percent (of Demographic) | Number | Percent (of Reported) | Percent (of Demographic) | Number | Percent (of Reported) | Percent (of Demographic) | Total | Unreported |
| All Births 2007-2009 | 21449 | | | 660 | 3% | | 5810 | 27% | | 14679 | 69% | | 21149 | 350 |
| Age | | | | | | | | | | | | | | |
| <20 | 2673 | 12% | | 99 | 15% | 4% | 708 | 12% | 27% | 1820 | 12% | 69% | 2627 | 46 |
| 20-34 | 16641 | 78% | | 510 | 77% | 3% | 4517 | 78% | 28% | 11344 | 76% | 69% | 16371 | 270 |
| >35 | 2135 | 10% | | 50 | 8% | 2% | 585 | 10% | 28% | 1467 | 10% | 70% | 2102 | 33 |
| Total | 21449 | | | 659 | | | 5810 | | | 14631 | | | 21100 | |
| Unreported | 0 | | | | | | | | | | | | | |
| Race | | | | | | | | | | | | | | |
| Caucasian | 14891 | 69% | | 330 | 50% | 2% | 3756 | 65% | 26% | 10589 | 72% | 72% | 14675 | 216 |
| African American | 6006 | 28% | | 322 | 49% | 5% | 1875 | 32% | 32% | 3681 | 25% | 63% | 5878 | 128 |
| Other | 552 | 3% | | 7 | 1% | 1% | 166 | 3% | 31% | 361 | 2% | 68% | 534 | 5 |
| Total | 21449 | | | 659 | | | 5797 | | | 14631 | | | 21087 | |
| Unreported | 0 | | | | | | | | | | | | | |
| Education (Highest Level) | | | | | | | | | | | | | | |
| Some High School, No Diplor | 4046 | 19% | | 273 | 41% | 7% | 1388 | 24% | 35% | 2301 | 16% | 58% | 3962 | 84 |
| High School Graduate | 5798 | 27% | | 220 | 33% | 4% | 1617 | 28% | 28% | 3874 | 26% | 68% | 5711 | 87 |
| Some College, No Degree | 5119 | 24% | | 105 | 16% | 2% | 1280 | 22% | 25% | 3643 | 25% | 72% | 5028 | 91 |
| Associates Degree | 1824 | 9% | | 25 | 4% | 1% | 412 | 7% | 23% | 1358 | 9% | 76% | 1795 | 29 |
| Bachelor's Degree or Higher | 4628 | 22% | | 33 | 5% | 1% | 1095 | 19% | 24% | 3446 | 23% | 75% | 4574 | 54 |
| Total | 21415 | | | 656 | | | 5792 | | | 14622 | | | | |
| Unreported | 34 | | | 3 | | | 18 | | | 9 | | | | 34 |
| Payment Method | | | | | | | | | | | | | | |
| Private Insurance | 9838 | 46% | | 111 | 17% | 1% | 2379 | 41% | 24% | 7224 | 49% | 74% | 9714 | 124 |
| Medicaid | 9459 | 45% | | 396 | 62% | 4% | 2865 | 50% | 31% | 6031 | 41% | 65% | 9292 | 167 |
| Self Pay | 1025 | 5% | | 124 | 19% | 12% | 356 | 6% | 35% | 530 | 4% | 52% | 1010 | 15 |
| Other (Incl. Tricare) | 905 | 4% | | 12 | 2% | 1% | 147 | 3% | 17% | 726 | 5% | 82% | 885 | 20 |
| Total | 21227 | | | 643 | | | 5747 | | | 14511 | | | | |
| Unreported | 222 | | | 16 | | | 63 | | | 120 | | | | 23 |
| Marital Status | | | | | | | | | | | | | | |
| Single | 10804 | 50% | | 525 | 80% | 5% | 3271 | 56% | 31% | 6812 | 45% | 64% | 10608 | 196 |
| Married | 10645 | 50% | | 134 | 20% | 1% | 2539 | 44% | 24% | 7819 | 52% | 75% | 10492 | 153 |
| Total | 21449 | | | 659 | | | 5810 | | | 14631 | | | | |
| Unreported | 0 | | | 0 | | | 0 | | | 0 | | | | |
| WIC Participant | | | | | | | | | | | | | | |
| Yes | 9518 | 45% | | 278 | 42% | 3% | 2655 | 46% | 24% | | | | 11118 | 164 |
| No | 11869 | 55% | | 378 | 58% | 2% | 3129 | 54% | 17% | | | | 18113 | 177 |
| Total | 21387 | | | 656 | | | 5784 | | | | | | | |
| Unreported | 62 | | | 3 | | | 26 | | | | | | | 8 |

# Appendix B

**Maternal Child Health Outcomes Based on Unadjusted Adequacy of Prenatal Care Model**

| | | | | Adequacy of Prenatal Care | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Outcome** | **Total** | **Percent** | | **<4** | **Percent (of Reported)** | **Percent (of Outcome)** | **4 to 10** | **Percent (of Reported)** | **Percent (of Outcome)** | **11+** | **Percent (of Reported)** | **Percent (of Outcome)** | **Unknown** |
| **Gestational Age** | | | | | | | | | | | | | |
| <34 Weeks | **807** | 4% | | 91 | 14% | 11% | 353 | 6% | 44% | 348 | 2% | 43% | 15 |
| 34-36 | **1820** | 9% | | 98 | 15% | 5% | 632 | 11% | 35% | 1046 | 7% | 57% | 44 |
| 37-40 | **16352** | 77% | | 367 | 57% | 2% | 4175 | 72% | 26% | 11565 | 79% | 71% | 245 |
| 41-45 | **2393** | 11% | | 83 | 13% | 3% | 630 | 11% | 26% | 1639 | 11% | 68% | 41 |
| **Total** | **21372** | **100%** | | **639** | **100%** | **3%** | **5790** | **100%** | **27%** | **14598** | **100%** | **68%** | **345** |
| Unknown | **77** | | | 20 | | | 20 | | | 33 | | | 4 |
| **Birthweight** | | | | | | | | | | | | | |
| VLBW | **351** | 2% | | 50 | 8% | 14% | 171 | 3% | 49% | 122 | 1% | 35% | 8 |
| LBW | **1592** | 7% | | 88 | 13% | 6% | 534 | 9% | 34% | 931 | 6% | 58% | 39 |
| NBW | **17744** | 83% | | 494 | 76% | 3% | 4710 | 81% | 27% | 12265 | 84% | 69% | 275 |
| HBW | **1750** | 8% | | 21 | 3% | 1% | 391 | 7% | 22% | 1311 | 9% | 75% | 27 |
| **Total** | **21437** | | | **653** | **100%** | **3%** | **5806** | **100%** | **27%** | **14629** | **100%** | **68%** | **349** |
| Unknown | **12** | | | 6 | | | 4 | | | 2 | | | |
| **Breastfeeding at Discharge** | | | | | | | | | | | | | |
| Yes | **13984** | 67% | | 181 | 29% | 1% | 3541 | 63% | 25% | 10076 | 69% | 72% | 186 |
| No | **6936** | 33% | | 436 | 71% | 6% | 2104 | 37% | 30% | 4258 | 29% | 61% | 138 |
| **Total** | **20920** | | | **617** | **100%** | **3%** | **5645** | **100%** | **27%** | **14334** | **100%** | **69%** | **324** |
| Unknown | **529** | | | 42 | | | 165 | | | 297 | | | 25 |
| **Planned Cesarean Section** | | | | | | | | | | | | | |
| Yes | **4265** | 20% | | 117 | 18% | 3% | 1028 | 18% | 24% | 3054 | 20% | 72% | 66 |
| No | **17184** | 80% | | 542 | 82% | 3% | 4782 | 82% | 28% | 11577 | 77% | 67% | 283 |
| **Total** | **21449** | | | **659** | **100%** | **3%** | **5810** | **100%** | **27%** | **14631** | **100%** | **68%** | **349** |
| Unknown | **0** | | | 0 | | | 0 | | | 0 | | | 0 |
| **Smoking Cessation** | | | | | | | | | | | | | |
| Non Smoker | **17520** | **82%** | | 424 | 65% | 2% | 4532 | 78% | 26% | 12295 | 84% | 70% | 269 |
| Quit | **541** | **3%** | | 21 | 3% | 4% | 166 | 3% | 31% | 341 | 2% | 63% | 13 |
| Decreased Amt | **735** | **3%** | | 37 | 6% | 5% | 251 | 4% | 34% | 425 | 3% | 58% | 22 |
| No Change | **2482** | **12%** | | 166 | 25% | 7% | 804 | 14% | 32% | 1473 | 10% | 59% | 39 |
| Increased Amt | **133** | **1%** | | 7 | 1% | 5% | 43 | 1% | 32% | 81 | 1% | 61% | 2 |
| **Total** | **21411** | | | **655** | **100%** | **3%** | **5796** | **100%** | **27%** | **14615** | **100%** | **68%** | **345** |
| Unknown | **38** | | | 4 | | | 14 | | | 16 | | | 4 |

Appendix C

**Maternal Child Health Outcomes based on Adjusted Adequacy of Prenatal Care Model**

| | | | Adjusted Adequacy of Prenatal Care | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Inadequate | | | Adequate | | | | |
| **Outcome** | **Total** | **%** | **N** | **% of N Total** | **% of Outcome** | **N** | **% of N Total** | **% of Outcome** | **Total** | **%** |
| **Gestational Age** | | | | | | | | | | |
| <34 Weeks | **807** | 4% | | | | | | | | |
| 34-36 | **1820** | 9% | 491 | 5% | 27% | 1260 | 15% | 69% | **1751** | 10% |
| 37-40 | **16352** | 77% | 8815 | 95% | 54% | 7067 | 85% | 43% | **15882** | 90% |
| 41-45 | **2393** | 11% | | | | | | | | |
| **Total** | **21372** | **100%** | **9306** | | **44%** | **8327** | | **39%** | **17633** | |
| Unknown | **77** | | | | | | | | | |
| **Birthweight** | | | | | | | | | | |
| VLBW | **353** | 2% | 6 | 0% | 2% | 11 | 0% | 3% | **17** | 0% |
| LBW | **1592** | 7% | 408 | 4% | 26% | 744 | 9% | 47% | **1152** | 7% |
| NBW | **17744** | 83% | 8119 | 87% | 46% | 6966 | 84% | 39% | **15085** | 86% |
| HBW | **1750** | 8% | 769 | 8% | 44% | 605 | 7% | 35% | **1374** | 8% |
| **Total** | **21439** | | **9302** | | **43%** | **8326** | | **39%** | **17628** | |
| Unknown | **10** | | 4 | | | 1 | | | | |
| **Breastfeeding at Discharge** | | | | | | | | | | |
| Yes | **13984** | 67% | 5926 | 65% | 42% | 5746 | 70% | 41% | **11672** | 68% |
| No | **6936** | 33% | 3149 | 35% | 45% | 2429 | 30% | 35% | **5578** | 32% |
| **Total** | **20920** | | **9075** | | **43%** | **8175** | | **39%** | **17250** | |
| Unknown | **529** | | | | | | | | | |
| **Planned Cesarean Section** | | | | | | | | | | |
| Yes | **4265** | 20% | 1540 | 17% | 36% | 1710 | 21% | 40% | **3250** | 18% |
| No | **17184** | 80% | 7766 | 83% | 45% | 6617 | 79% | 39% | **14383** | 82% |
| **Total** | **21449** | | **9306** | | 43% | **8327** | | **39%** | **17633** | |
| Unknown | **0** | | | | | | | | | |
| **Smoking Cessation** | | | | | | | | | | |
| Non Smoker | **17520** | **82%** | 7490 | 81% | 43% | 6999 | 84% | 40% | **14489** | 82% |
| Quit | **541** | **3%** | 237 | 3% | 44% | 187 | 2% | 35% | **424** | 2% |
| Decreased Amt | **735** | **3%** | 330 | 4% | 45% | 233 | 3% | 32% | **563** | 3% |
| No Change | **2482** | **12%** | 1172 | 13% | 47% | 853 | 10% | 34% | **2025** | 12% |
| Increased Amt | **133** | **1%** | 58 | 1% | 44% | 46 | 1% | 35% | **104** | 1% |
| **Total** | **21411** | | **9287** | | 43% | **8318** | | **39%** | **17605** | |
| Unknown | **38** | | | | | | | | | |

Appendix D

**Odds Ratio for all Outcomes based on Unadjusted and Adjusted Adequacy of Prenatal Care Models**

**Unadjusted APNC**

| | Disease Status- Prematurity | | | | |
|---|---|---|---|---|---|
| Exposure | Yes- 34-36w | No- 37-40w | Total | Oi | **OR** |
| Yes- Inadequ | 730 | 4542 | 5272 | 0.16 | **1.78** |
| No- Adequat | 1046 | 11565 | 12611 | 0.09 | CI: 1.61-1.97 |
| Total | 1776 | 16107 | 17883 | | |

**Adjusted APNC**

| | Disease Status- Prematurity | | | | |
|---|---|---|---|---|---|
| Exposure | Yes- 34-36w | No- 37-40w | Total | Oi | **OR** |
| Yes- Inadequ | 491 | 8815 | 9306 | 0.06 | **0.31** |
| No- Adequat | 1260 | 7067 | 8327 | 0.18 | CI: 0.28-0.35 |
| Total | 1751 | 15882 | 17633 | | |

**Unadjusted APNC**

| | Disease Status- Low Birth Weight | | | | |
|---|---|---|---|---|---|
| Exposure | Yes- LBW | No- NBW | Total | Oi | **OR** |
| Yes- Inadequ | 843 | 5204 | 6047 | 0.16 | **1.89** |
| No- Adequat | 1053 | 12265 | 13318 | 0.09 | CI: 1.71-2.08 |
| Total | 1896 | 17469 | 19365 | | |

**Adjusted APNC**

| | Disease Status- Low Birth Weight | | | | |
|---|---|---|---|---|---|
| Exposure | Yes- LBW | No- NBW | Total | Oi | **OR** |
| Yes- Inadequ | 414 | 8119 | 8533 | 0.05 | **0.47** |
| No- Adequat | 755 | 6966 | 7721 | 0.11 | CI:0.42-0.53 |
| Total | 1169 | 15085 | 16254 | | |

**Unadjusted APNC**

| | Disease Status- Breastfeeding | | | | |
|---|---|---|---|---|---|
| Exposure | BF | Not BF | Total | Oi | **OR** |
| No- Adequat | 10076 | 4258 | 14334 | 2.37 | **1.61** |
| Yes- Inequat | 3722 | 2540 | 6262 | 1.47 | CI: 1.52-1.72 |
| Total | 13798 | 6798 | 20596 | | |

**Adjusted APNC**

| | Disease Status- Breastfeeding | | | | |
|---|---|---|---|---|---|
| Exposure | BF | Not BF | Total | Oi | **OR** |
| No- Adequat | 5746 | 2429 | 8175 | 2.37 | **1.26** |
| Yes- Inequat | 5926 | 3149 | 9075 | 1.88 | CI: 1.18-1.34 |
| Total | 11672 | 5578 | 17250 | | |

**Unadjusted APNC**

| | Disease Status- PCS | | | | |
|---|---|---|---|---|---|
| Exposure | Yes- PCS | No PCS | Total | Oi | **OR** |
| Yes- Adequat | 3054 | 11577 | 14631 | 0.26 | **1.23** |
| No- Inadequa | 1145 | 5324 | 6469 | 0.22 | CI: 1.14-1.32 |
| Total | 4199 | 16901 | 21100 | | |

**Adjusted APNC**

| | Disease Status- PCS | | | | |
|---|---|---|---|---|---|
| Exposure | Yes- PCS | No PCS | Total | Oi | **OR** |
| Yes- Adequat | 1710 | 6617 | 8327 | 0.26 | **1.30** |
| No- Inadequa | 1540 | 7766 | 9306 | 0.20 | CI: 1.21-1.41 |
| Total | 3250 | 14383 | 17633 | | |

**Unadjusted APNC**

| | Disease Status- Smoking Cessation | | | | |
|---|---|---|---|---|---|
| Exposure | Yes- Still Sm | No- Quit Smo | Total | Oi | **OR** |
| Yes- Inadequ | 1308 | 187 | 1495 | 6.99 | **1.21** |
| No- Adequat | 1979 | 341 | 2320 | 5.80 | CI: 1.00-1.46 |
| Total | 3287 | 528 | 3815 | | |

**Adjusted APNC**

| | Disease Status- Smoking Cessation | | | | |
|---|---|---|---|---|---|
| Exposure | Yes- Still Sm | No- Quit Smo | Total | Oi | **OR** |
| Yes- Inadequ | 1560 | 237 | 1797 | 6.58 | **1.09** |
| No- Adequat | 1132 | 187 | 1319 | 6.05 | CI: 0.88-1.34 |
| Total | 2692 | 424 | 3116 | | |

Appendix E: Public Health Competencies Met

| Specific Competencies |
|---|
| **Domain #1: Analytic Assessment Skill** |
| Defines a problems |
| Determines appropriate uses and limitations of both quantitative and qualitative data |
| Selects and defines variables relevant to defined public health problems |
| Identifies relevant and appropriate data and information sources |
| Evaluates the integrity and comparability of data and identifies gaps in data sources |
| Applies ethical principles to the collection, maintenance, use, and dissemination of data and information |
| Partners with communities to attach meaning to collected quantitative and qualitative data |
| Makes relevant inferences from quantitative and qualitative data |
| Obtains and interprets information regarding risks and benefits to the community |
| Applies data collection processes, information technology applications, and computer systems storage/retrieval strategies |
| Recognizes how the data illuminates ethical, political, scientific, economic, and overall public health issues |
| **Domain #2: Policy Development/Program Planning Skills** |
| Collects, summarizes, and interprets information relevant to an issue |
| Utilizes current techniques in decision analysis and health planning |
| Decides on the appropriate course of action |
| **Domain #3: Communication Skills** |
| Communicates effectively both in writing and orally, or in other ways |
| Solicits input from individuals and organizations |
| Advocates for public health programs and resources |
| Uses the media, advanced technologies, and community networks to communicate information |
| Effectively presents accurate demographic, statistical, programmatic, and scientific information for professional and lay audiences |
| Attitudes |
| Listens to others in an unbiased manner, respects points of view of others, and promotes the expression of diverse opinions and perspectives |
| **Domain #4: Cultural Competency Skills** |
| Identifies the role of cultural, social, and behavioral factors in determining the delivery of public health services |
| **Domain #5: Community Dimensions of Practice Skills** |
| Collaborates with community partners to promote the health of the population |
| Develops, implements, and evaluates a community public health assessment |

| Specific Competencies |
| --- |
| **Domain #6: Basic Public Health Sciences Skills** |
| Identifies the individual's and organization's responsibilities within the context of the Essential Public Health Services and core functions |
| Defines, assesses, and understands the health status of populations, determinants of health and illness, factors contributing to health promotion and disease prevention, and factors influencing the use of health services |
| Identifies and applies basic research methods used in public health |
| Applies the basic public health sciences including behavioral and social sciences, biostatistics, epidemiology, environmental public health, and prevention of chronic and infectious diseases and injuries |
| Identifies and retrieves current relevant scientific evidence |
| Identifies the limitations of research and the importance of observations and interrelationships |
| Attitudes |
| Develops a lifelong commitment to rigorous critical thinking |
| **Domain #7: Financial Planning and Management Skills** |
| Manages information systems for collection, retrieval, and use of data for decision-making |
| **Domain #8: Leadership and Systems Thinking Skills** |
| Helps create key values and shared vision and uses these principles to guide action |
| Identifies internal and external issues that may impact delivery of essential public health services (i.e. strategic planning) |
| Facilitates collaboration with internal and external groups to ensure participation of key stakeholders |